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SOME RECENT ADVANCES IN SURGICAL THERAPEUSIS*

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EVER since the Philadelphia Academy of Surgery was founded by the elder Gross and his surgical contemporaries it has stood for the maintenance of the highest ideals in the art of surgery and for the advancement of the science of surgery. When Doctor Gross called a meeting of certain surgeons to organize the academy, surgical anesthesia was still an infant, antisepsis had just been born, and asepsis had not yet been conceived. As these developed they permitted a degree of safety in operations which previously was beyond the hopes of even the most brilliant of surgical adventurers. During the latter part of the nineteenth and the early part of the present century, technical advances took place with amazing rapidity and operations on important viscera became commonplace. Many of the developments in abdominal surgery preceded our knowledge of the physiology of the organs that were being subjected to operation, so that much of our present knowledge of function was made possible because of these technical advances.

For many years, therefore, surgeons focused their attention on improvements in operative technic and neglected factors of equal importance in their effect on surgical morbidity and mortality. An important result of the developments in the basic medical sciences, and of the changing training of our medical students, and of those seeking a career in surgery, has been a better understanding of the processes involved in a normal physiologic mechanism and a more comprehensive knowledge of the alterations from the normal which occur in disease.

It is unfortunate that during this physiologic era in medicine many practitioners have been of the opinion that medicine and surgery were in danger of becoming too scientific, and that the recipients of undergraduate and graduate training were being so cluttered with nonessentials that they would make poor practitioners. Many of the critics have been men of high ideals and great intellectual integrity, and yet, unwittingly, have failed to comprehend the fact that if surgery is to remain a dynamic force in medicine, the art and science of surgery must move forward together.

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If the ultimate aim of surgery is to restore function, it can be reached only by an increasing knowledge of fundamental physiology, and by a broader appreciation of the changes which take place in the body economy in disease. Such knowledge will permit of a wider concept of pathologic physiology and must inevitably lead to greater safeguards for the individual patient before, during, and after operation. In such a concept, surgical therapeusis takes on a new meaning, and the operation forms but a part, and often a small part, of what surgery has to offer. The surgeon at the bedside, which can be an excellent laboratory for investigation, interprets and utilizes the fundamental observations of the physiologist and the internist and adds to these a worthwhile share of his own. I shall discuss a few problems in surgical therapeusis in order to illustrate this viewpoint. That I have selected subjects in which my associates have been interested is because of my greater familiarity with them. I might just as well have selected a number of other subjects.

Nutrition in Surgical Patients.—One of the most common conditions with which we, as surgeons, are confronted in surgical practice is malnutrition. Its existence is even more widespread than is commonly believed, and its effects, while usually supposed to bear some relationship to resistance, are of a much more profound character.

Although the volume of the circulating blood is primarily dependent on the supply and nature of the electrolytes and the available water in the organism, other substances, principally the plasma proteins, play an important part in maintaining the proper fluid balance between the extracellular fluid and the circulating fluid in the blood vessels.

The volume of the circulating blood of normal human beings has been estimated to be from one-tenth to one-twentieth of the body weight. Smith and Mendel have injected intravenously into normal rabbits sufficient amounts of solutions of various neutral sodium salts to double the blood volume, and in every case they found that although most of the fluid was lost from the circulating blood within five minutes, there was in no instance evident tissue edema. When, however, the plasma protein concentration is reduced to a critical level prior to the injection of the solutions, the result is quite different, for edema occurs.

A prolonged restriction of protein intake results in a deficiency of the labile protein stores, and these are often reduced to the zero point by long continued anemia or bleeding during periods of protein restriction. As the plasma proteins are reduced in concentration from the normal level of approximately 7.5 Gm. per 100 cc. of blood, the circulating fluid begins to leave the vessels, resulting first in a latent and later, when the concentration approaches 5.5 Gm. per 100 cc. of blood, in an evident tissue edema. In undernourished patients, the excess use of sodium chloride still further accentuates the edema, for the use of large amounts of sodium salts in hypoproteinemic patients is conducive to the production of edema at a plasma-protein concentration above the critical level of edema. This rôle of the plasma proteins, which by virtue of their osmotic properties play an important part in main-

taining a delicate state of balance between the blood and the extravascular fluid, is of considerable importance in a variety of lesions which we are called upon to treat.

In pyloric obstruction, in gastric and duodenal ulcer and gastric carcinoma, and in long-standing biliary tract disease, where over a period of time there has been a marked restriction in the diet, a deficiency in the total plasma proteins nearly always exists when the patient is first seen, but in many patients the concentration of the plasma protein is at this time within, or about, the normal limits because of dehydration. When the existing dehydration is overcome, the plasma-protein concentration is very often low and tissue edema may result. These facts have been ignored frequently, I believe, in correcting dehydration in our patients. Too much emphasis has been placed on the water and salt requirements of the surgical patient and too little on the mechanisms involved in keeping fluid in blood vessels.

Of the greatest importance is the fact that edema may affect not only the subcutaneous tissues but the tissues of various viscera as well. Jones and Eaton were, I believe, the first to call attention to the fact that nutritional edema may readily occur as a complication of a variety of surgical conditions. Frequently edema is not grossly evident prior to operation, but as a result of further diet restriction imposed by the very nature of the operation, and associated with a restoration, or the administration of an excess of fluid and salt during the postoperative period, edema may result.

Mecray, Barden and Ravdin have shown that there exists a very close relationship between the rate of gastric emptying and the level of the plasma protein. With increasing evidence of tissue edema, the gastric emptying time of the normal stomach, or the stomach which has been operated upon, increases. Subsequent investigations demonstrated that the motility of the small intestine was also reduced in the presence of tissue edema, that is, the time necessary for a bolus of barium to pass from duodenum to cecum was prolonged.

We have had evidence, on a number of occasions, that a reduction of the plasma proteins after gastric operations may so accentuate the edema of trauma that the postoperative picture mimics in every way a technical defect in the anastomosis. We are convinced that more than one patient has been subjected to a secondary operation, with its attendant high mortality, for a supposed technical error in the operative procedure, when in reality the obstruction was in the main the result of a disturbance in the labile protein stores.

We have approached the problem of hypoproteinemia in our gastro-intestinal cases in a varied manner. Some of these patients have received blood, others normal plasma, while others have been given injections of lyophile serum. The frequency with which reactions have occurred following the injection of lyophile serum, given in a normal or concentrated form, makes us hesitate to suggest the more general acceptance of this material.

The use of amino-acid mixtures for correcting hypoproteinemia, while

correct in theory, has not been successful in our hands. Until more is known about the essential amino-acids and the amounts necessary for protein regeneration, the method will be of no clinical significance.

Since operations on the upper gastro-intestinal tract have a profound, temporary influence on enzyme production in the liver, pancreas, stomach and upper small bowel, we have prepared a protein material which is predigested, so that when made into solution it can be absorbed from the large or small bowel without further hydrolysis.

Rhoads, Stengel, Riegel and Frazier have found that this protein hydrolysate is absorbed from the large and small bowel of the dog and of man. Just prior to operation, in selected gastric cases, a special two-lumen tube, devised by Abbott, is passed into the stomach. Immediately after completing the closure of the new stoma, the distal end of the tube is drawn through the stoma and down into the jejunum for 12 to 18 inches. Following operation the stomach is kept empty through one lumen while food, by a method devised by Stengel and Vars, is administered through the distally open lumen. Not only protein, but glucose and salt may be introduced into the bowel, so that intravenous injections are, as a rule, not required. The success which has attended the use of this method in preventing or correcting hypoproteinemia in our patients leads us to recommend it in the management of hypoproteinemia in patients subjected to gastric operations. Such methods permit of a more adequate program to fulfill nutritional requirements and lead to a better end-result, with less risk to the patient.

Not only is edema of the gastro-intestinal tract of serious consequence in the restoration of normal gastro-intestinal continuity, but the reduction of the plasma proteins is often associated with other serious catastrophes. Hypoproteinemic patients are, we believe, more susceptible to postoperative pulmonary complications. These patients frequently have signs of mild pulmonary congestion, especially when large amounts of sodium chloride are administered during the postoperative period, and such a state is very probably a precipitating factor in the more serious complications of atelectasis and infection.

Thompson, Frank and Ravdin have shown that disruption of a wound after an abdominal operation in the dog is frequently associated with a lowering of the plasma-protein concentration, and we have recently had confirmation of these findings in several patients. Proliferation of fibroblasts is greatly retarded under these conditions, but when the plasma-protein concentration is restored to normal, wound healing takes place promptly if other deficiencies have been prevented.

Not only are the plasma proteins of importance in normal gastro-intestinal activity, but certain accessory food factors, namely, the vitamins, are equally important. A deficiency in the vitamin B complex, which rapidly occurs in many gastro-intestinal disorders, febrile states, and hyperthyroidism, results in gastro-intestinal atony, and in a delay in gastric emptying and small intestinal motility. In hypoproteinemia, in the absence of a vitamin B deficiency,

hyperperistalsis is observed even though the stomach may not empty, but when the two conditions coexist, the atonic stomach is lacking in peristaltic activity.

Recently, Lanman and Ingalls have shown that a deficiency in vitamin C is an important factor in the failure of certain wounds to heal and thus two nutritional factors, deficiencies of which are readily encountered in surgical patients, are now known to play important rôles in the failure of wounds to heal. The use of adequate amounts of cevitamic acid in the pre- and post-operative periods of patients, known or suspected to have a low blood ascorbic acid level, will overcome one of the important factors influencing the normal processes of fibroblastic proliferation.

Within the past year, we have witnessed, in large part, the solution of another surgical complication. Ever since the surgery of the biliary tract made possible the exploration of the common duct for obstructive jaundice, one of the major causes of death has been postoperative hemorrhage. For years surgeons have lulled themselves into a sense of false security by pouring various calcium salts into the veins of these patients. In 1929, Morrison and Ravdin reported that, except in those instances where there was a low plasma-protein concentration, no calcium deficiency existed in jaundiced patients, and even in such instances there was no deficiency in the available ionizable calcium.

Some patients were helped by the intravenous administration of glucose; more were helped by pre- and especially postoperative transfusions, but the incidence of hemorrhage and the resultant mortality remained high. We had not long to wait. The researches of Dam, Almquist and Quick, and those of Greaves and Schmidt, have completed the story of another conditioned deficiency; just as Castle's classic experiment proved pernicious anemia to be a conditioned deficiency.

It is now known that vitamin K, a fat-soluble vitamin, is not absorbed from the intestinal tract that is deprived of bile salt, and this vitamin is essential for the elaboration of prothrombin which plays an important rôle in the clotting mechanism. Thus the patient with long-standing biliary tract disease and severe hepatitis, the patient with a complete, or nearly complete external biliary fistula, or the patient with obstructive jaundice who has a complete absence, or an insufficient amount of bile salt entering the intestine is unable to absorb vitamin K from his diet and is susceptible to a deficiency in prothrombin with a tendency to bleed after operation.

Eight years ago we began the method of feeding bile to patients with biliary fistulae. At first we used the patient's bile but later we showed that several weeks often elapsed after the removal of a common duct obstruction before bile salt reappeared in the patient's bile. These observations led us to feed patients with external fistulae a normal lyophilized bile which can be given in capsule form and which is capable of fulfilling the intestinal functions of bile.

More recently, Johnston and Winfield have used this material during the

preoperative period. Our technic at present is to administer a crude preparation of vitamin K and sodium desoxycholate or lyophile bile during the pre- and postoperative periods, and with this method we have not had a single instance of severe hemorrhage in a jaundiced patient for eight months.

Anesthesia.—From the time that Crawford Long first used ether for surgical anesthesia until the present, a wide variety of substances have been recommended for use. History has repeated itself, time and again, when, as the result of enthusiastic reports, surgeons have adopted new agents only to discard them as clinical experience with these substances increased.

The new substances advanced for use in surgical anesthesia are too many to name, or to enumerate their advantages and disadvantages. Certain generalizations concerning them can, however, be given, with the hope that we may be guided by common sense rather than be exploited by pharmaceutic advertising.

In general, the use of any substance for complete anesthesia which depends upon the administration of an amount based upon body weight should be discouraged, because it fails to take into consideration the individual reaction of the patient to the drug. Since very few, if any, of these substances have a specific antidote, they are in all instances potentially dangerous.

The various barbituric acid derivatives, according to Taylor, are most useful in providing sedation some hours before anesthetization, so that they do not cause depression of the respiration during anesthesia. Halsey has shown that dogs breathing subanesthetic concentrations of ether develop surgical anesthesia when given 20 per cent of the minimal lethal dose of certain barbiturates. The studies of Seevers, Meek, Rovenstine and Stiles, who found that preliminary morphine medication reduced the concentration of cyclopropane necessary to maintain third stage anesthesia by 66.5 per cent, are of great importance and further strengthen the idea that preanesthetic medication is of definite value.

Of the newer general anesthetics, divinyl ether and cyclopropane, much could be said. Suffice it to say at this time, however, that they are powerful anesthetics in that they both induce surgical anesthesia with a blood concentration of the anesthetic approximately one-half that of chloroform. They are, therefore, useful, but at the same time potentially dangerous agents.

Of primary importance in selecting an agent for surgical anesthesia is a consideration of its effect on visceral tissues. It was shown many years ago by Opie and Alford, and later by Davis, Whipple and Hall, that an adequate supply of carbohydrate in the diet protected the dog from the necrotizing effect of chloroform. It has been generally agreed that the bad risk liver patient will withstand anesthesia and operation better, regardless of the general anesthetic employed, when the deposits of liver glycogen are adequate. No one has explained why the liver glycogen had this beneficent protective effect. Experiments which Vars, Goldschmidt and Ravdin have been conducting demonstrate that the protective action of a large amount of liver glycogen depends, in large part, upon the fact that, as a rule, in the normal

animal the deposition of glycogen in the liver results in the displacement of the liver fat. Furthermore, a high carbohydrate dietary protects the reserve stores of protein in the liver which we have found to play an important rôle in protection against hepatotoxic agents. A high liver glycogen content is not, however, always associated with a low liver lipid, a circumstance we have repeatedly demonstrated, in man and experimental animal, in the presence of liver injury. When the concentration of liver fat increases above the normal, and the reserve stores of protein are seriously reduced, liver necrosis is apt to occur when the patient is subjected to a variety of anesthetic agents, regardless of the glycogen level. The major conditioning factor in the production of liver necrosis following the use of anesthetics which are lipoid solvents is the amount of liver fat present in the individual instance and not the concentration of liver glycogen. Anesthetics that are excellent lipoid solvents will produce the greater injury, as the liver fat will hold a higher concentration of the anesthetic for a longer period of time. The deposition of large amounts of liver glycogen, therefore, is useful only if the liver fat is simultaneously displaced.

Experiments which Goldschmidt, Vars, Johnson and Ravdin have been conducting point strongly to the importance of adequate protein in the diet if maximum protection is to be afforded the liver, as a carbohydrate-protein dietary is much more effective in reducing the content of hepatic lipid than is a carbohydrate diet alone. In patients, we are using a carbohydrate diet to which protein is added to the extent of at least 14 per cent of the total available calories. The use of large and frequent oral feedings is of much more importance than the use of glucose intravenously. Too much reliance, I believe, has hitherto been placed upon what can be accomplished by the intravenous injection of glucose. If food is not given by mouth to these patients, the glucose, administered intravenously, is used for the energy requirements of the patient; it is not deposited as glycogen in the liver.

Unfortunately, it is not always possible to prepare patients for some days prior to operation, nor is it always possible, even if the time were available, to induce the patient to eat, or the damaged liver cells to increase their glycogen stores.

Goldschmidt, Lucke and Ravdin have recently found that the employment of an adequate supply of oxygen in conjunction with the general anesthetic will, if the liver fat concentration is not too high, provide nearly as efficient protection to the liver as will a high carbohydrate diet for a few days prior to operation.

The less frequent use of chloroform, throughout the world, as an anesthetic has led numerous surgeons to suppose that liver injury or necrosis is not now frequent enough to concern us. The recent studies of Rosenthal and Bourne, and of Boyce show that liver injury after nearly every anesthetic now being used is a common occurrence. Fortunately it is often not extensive, and repair, under favorable conditions, is rapid. In the bad risk patient, how-

ever, even a minimal additional injury to the liver may precipitate incompetency in an organ previously shown by every functional test to be completely competent.

It is generally assumed that an ordinary ether and nitrous oxide-oxygen anesthesia are without any definite effect on liver tissue. We have obtained convincing evidence that this assumption is unwarranted. If, during ether anesthesia in the dog, the ether is volatilized with a mixture which contains only 15 per cent of oxygen, 5 per cent less than does air, a very marked degeneration in liver tissue occurs. It is quite likely that, frequently during ether anesthesia, a state of anoxia does exist in many of our surgical patients. Under such circumstances, the changes occurring in the liver may be of such serious consequence as to result in the subsequent death of the patient. The protective action of oxygen, therefore, is of considerable moment, since even with an increased liver-lipid concentration an adequate supply of oxygen during anesthesia will offer a considerable degree of liver protection.

I cannot leave the subject of anesthesia without saying a word about spinal anesthesia. There can be no doubt but that one can find certain definite objections to its use, but, on the other hand, there are a number of factors which favor its administration. For operations below the diaphragm, in amounts of novocain not exceeding 150 mg., with proper technic, the risk, in the hands of an experienced anesthetist, is not greater than with other anesthetic agents.

The proper use of ephedrine, as suggested by Ferguson and North, prior to anesthetization in individuals with an elastic peripheral vascular system, results in a rise in the pressure during anesthesia in a high percentage of our patients rather than a fall. The statement, frequently made, that vasoconstrictor substances should not be administered prior to the injection of a spinal anesthetic, because they may cause the further pooling of blood in the splanchnic circulation, is based upon a false assumption. The splanchnic, sympathetic vasoconstrictors are just as responsive to vasoconstrictor drugs as are the peripheral sympathetic fibers. It is high time that we kept abreast of modern physiologic advances and used them in interpreting the phenomena observed in man. More real nonsense has been written recently in regard to spinal anesthesia than any other subject with which we are at present daily concerned, and the constant reiteration that the fall in pressure is due solely to the splanchnic pooling of blood is a perfect example.

In this connection, I must challenge a recent statement by Boyce, that when the effects of various anesthetic agents on hepatic function were determined by the Quick hippuric acid test, spinal anesthesia was found to cause the most marked drop in hepatic function and ethylene the least. He admits that the patients given spinal anesthesia had reductions of the blood pressure, but does not state the extent of the fall or the period over which it persisted. Any reduction in blood pressure which leads to anoxemia, or a reduced blood flow through the liver, will cause hepatic injury. Boyce states further that ethylene is the most satisfactory anesthetic agent from the standpoint of its

effect upon liver function, but the data in his chart are not convincing, as the hepatic function, as determined by the Quick method, three days after anesthetization with ethylene, indicate more impairment than that following the employment of spinal anesthesia. We have reported that the most sensitive indicator of hepatic function is the concentration of bile acids in the hepatic bile. This concept has recently been accepted by Gray, Butsch and McGowan of the Mayo Clinic. Using the reduction in the bile salt concentration as evidence of liver injury, these authors found ethylene anesthesia to produce more serious liver injury than did spinal anesthesia.

With the patient protected against excessive or prolonged hypotension by the preliminary administration of ephedrine, spinal anesthesia with procaine is, I believe, the safest anesthetic in the presence of a badly injured liver. It is a dangerous anesthetic, but so, too, are all the potent anesthetics. To permit an intern to administer a spinal anesthetic and to insist on a professional anesthetist to administer cyclopropane is, to my mind, a matter of bad judgment. Any anesthetic agent in the hands of the tyro may be dangerous and spinal anesthesia is no exception. The inhalation anesthetics can effect the liver parenchyma by their effect on the hepatic blood flow, by producing hepatic anoxia, and by their direct effect upon the hepatic cells. This latter effect will be the more extensive the greater the concentration of liver fat and the lower the reserve protein stores. Spinal anesthesia can produce liver injury only by affecting blood flow and causing liver anoxia. It has no direct effect upon the liver cells.

Surgical Shock.—There is no subject in surgery of which more has been written and of which we have a poorer conception than surgical shock.

In 1893, Malcom, after careful study, came to the conclusion that shock was associated with arteriolar constriction rather than with arteriolar relaxation. His reasoning was clear and logical but his work came at a time when most clinicians felt that the researches by Crile had settled the subject for all time. Crile advanced the theory that the marked physiologic mental depression associated with shock was the result of exhaustion of vital nerve centers by painful stimuli. He demonstrated morphologic changes in the brain cells of various animals following prolonged injury to distant tissues, as proof of his theory.

Investigators began to question whether the changes which Crile observed were cause or effect, and the death knell of the etiologic basis of the Crile theory was sounded by Forbes and his coworkers, who found that failure in the cerebral circulation, for only a very short period, produced nerve cell changes identical with those which Crile had described. These changes were the result of shock, not the cause of it.

During the World War, Keith, and Robertson and Bock discovered that in shock the blood volume was greatly reduced. At about the same time, Dale, Laidlow and Richards showed that histamine produced a change in capillary permeability with loss of plasma from the circulation. These two observations were combined by Cannon and Bayliss to establish the "Trau-

matic Toxemic" theory of shock. But no toxin has been identified in the circulating blood. The work of Parsons and Phemister, and Blalock and his associates, cast doubts upon the validity of this concept. Although this theory is no longer universally accepted, the careful work of these observers gave an insight into the problem such as we had not previously had.

It was finally established, and there is now universal agreement upon the fact, that the low blood pressure of surgical shock is the result of a diminished blood volume. The issue remaining is, how is the blood volume reduced? According to Blalock, enough plasma or blood is lost into a traumatized area to account for the reduction. His exact chemical analyses have done much to emphasize the importance of direct loss of blood or plasma into an injured area.

Freeman has offered another explanation of how the blood volume is reduced. He observed that vasoconstriction, with consequent impairment of circulation to the tissues in the experimental animal, led to shock with a lowered blood volume. This picture could be produced by prolonged injection of adrenalin or could occur from spontaneous hyperactivity of the sympathetic nervous system. In further observations upon clinical cases of surgical shock, he and his associates demonstrated the significance of a diminished flow of blood to the peripheral tissues as the centrally dominant feature of surgical shock. The importance of such a decrease in circulation was pointed out by Erlanger and his coworkers and by Gesell in experimental shock 20 years before.

There is, again, general agreement upon the fact that the peripheral circulation is markedly reduced in shock. The point at issue is, what function does vasoconstriction play? Is it a protective mechanism which is salutary or is it essentially destructive? The anwer is—both. In the face of a crisis such as severe trauma, hemorrhage, asphyxia, or even with the expectation of harm, as in fear or terror, the sympathetic system mobilizes the bodily mechanisms for supreme effort. In such a crisis, the function of vasoconstriction is protective. The vital centers are supplied with blood which is diverted from the periphery. But if the crisis is too protracted, and if the peripheral tissues are too long deprived of an adequate supply of blood, they are injured. The arteriolar constriction leads to stasis and anoxemia in the capillaries, and to the escape of protein-containing fluid into the tissues with an attending reduction of the blood volume. Shock begins when the tissues of the body receive too little blood for the maintenance of tissue metabolism.

In the treatment of surgical shock, restoration of a normal blood volume and a normal or adequate blood flow are of primary importance. If shock is slight and loss of plasma negligible, saline solutions alone may suffice. On the other hand, when, as a result of a loss of not only fluids, but protein, as occurs in severe shock, there is a marked depletion of the blood volume, it is necessary that some substances which do not easily escape from the blood vessels be administered with the fluid. The recent observations of Freeman demonstrate graphically the error in the concept of Baldridge and McFee.

Normal or hypertonic glucose or saline solutions do not remain in the circulation long enough to be of any permanent value when the shock-like state is thoroughly initiated. The substances most effectual are blood, plasma, and acacia. They should be employed in amounts sufficient to restore a normal pressure and evidences of a normal blood flow, and should be repeated when the pressure again falls.

Since cold causes stasis of the peripheral circulation, patients should be kept warm. Cases of injury and those subjected to prolonged anesthesia and operation should be guarded against a low environmental temperature, which may produce shock or further accentuate it. Trauma also produces stasis through vasoconstriction. The rougher the surgeon the greater will be the trauma and the higher the incidence of shock.

It is of the utmost importance that the surgeon have definite knowledge of the amount of fluid which may be lost by a patient during anesthesia and operation and during the period immediately following operation. The excellent studies initiated by Wiley and Newburgh on the fluid balance under a variety of environmental conditions have been extended by their associates, Coller and Maddock, and others.

Coller and Maddock found that the average patient loses approximately 1,000 cc. of fluid in the four-hour period during and after an operation, and that he loses approximately 2,000 cc. per day by insensible routes during the period of convalescence. When the considerable loss of fluid by routes which are not easily calculated in the surgical clinic is not controlled, dehydration will produce a corresponding reduction of the blood volume, and the patient becomes susceptible to shock.

Thus, surgical shock seems to be dependent upon a reduced blood volume and a deficient blood flow. It can be prevented by maintaining a normal blood volume and blood flow. It can be corrected by restoring a depleted volume and a reduced blood flow, with substances which will remain in the circulation. Treatment, however, must be started early, before irreversible changes take place and the integrity of the cells of the body is lost.

Intestinal Intubation.—Although the early work of Hartwell, and the later work of Haden and Orr, gave us a better understanding of certain of the biochemical changes occurring in the higher types of intestinal obstruction, no material reduction in the mortality attended the restoration of the fluid and salt balance in this condition. While a disturbance in the fluid and salt balance may lead to serious consequences in acute intestinal obstruction, the mere restoration of fluid and salt is inadequate to offset the more serious results of other factors associated with this condition.

The later observations of Meek and Herrin, Taylor, and Wangensteen and Paine, demonstrated that distention of the bowel was of equal, or even more, importance in a consideration of the pathologic physiology of acute bowel obstruction.

Distention causes an impediment to the flow of blood in the bowel wall. There result, first, venous stasis and transudation of fluid into the lumen

of the intestine. As the distention increases, the arterial blood flow is affected and, as a result of this, the vitality and integrity of the bowel wall suffer, leading, first, to hemorrhages into the wall, and later, if the condition persists, or is accentuated, to necrosis.

The introduction of the principle of syphon drainage of the stomach and upper gastro-intestinal tract, by Wangensteen and Paine, did more to reduce the mortality of acute intestinal obstruction than any other advance during the preceding 30 years. In the absence of herniation, and when a reasonable doubt existed that gangrene was not present, it was no longer necessary that "the sun must not rise or set on a case of acute intestinal obstruction." Operation could be performed when the fluid and salt balance of the patient had been replenished and reestablished; when distention had been, in part at least, relieved; and when the blood volume and blood flow had been restored. Jejunostomies and ileostomies, operations which were frequent in every surgical clinic, now became rarities. Not only was the method which they advocated of use in many of the obstructions of a dynamic nature, but it was of equal importance in those obstructions associated with peritoneal infection, for in them distention is an important factor in the final collapse of the peripheral circulation which is observed in the terminal stages of peritonitis.

Distention reduces the circulating blood volume by the transudation of fluid into the lumen of the bowel, and by the effect of distention on the rate of blood flow to and from the heart in the great vessels below the diaphragm. Thus, the minute output of blood from the heart is reduced, still further affecting the rate of blood flow, and, to all intents and purposes, the exciting factors in the production of shock are initiated.

Wangensteen and Paine were loath to advocate syphon drainage for acute obstructive lesions of the large bowel. The frequency with which a competent ileocecal valve prevents the regurgitation of fluid and gas into the small intestine made them extremely cautious in advocating their method for obstructions of the large bowel.

Charles G. Johnston and William Osler Abbott conceived the idea that if the entire bowel down to the point of obstruction could be emptied, the principle of syphon drainage could be extended, greatly to the advantage of both patient and surgeon. The method which they developed, when successfully conducted, empties the bowel down to the point of obstruction. It can be employed in either dynamic or adynamic ileus. The fact that the balloon advances, even in patients with widespread peritoneal infection, may force us to revise our ideas of the mechanism of so-called "paralytic" ileus.

With the use of the original Miller-Abbott intestinal tube, or a modification of it, these men have been able to obtain their objective in a very high percentage of cases, with either high or low obstruction; and in their hands, and in ours, we have witnessed the first great reduction in mortality resulting from this condition. In nearly 100 patients, treated by Johnston, the mortality is just over 9.0 per cent.

The method of Abbott and Johnston permits of evacuation of the bowel down to the obstruction; of the feeding of low residue diets up to the time of operation; of more careful and specific localization of the point of obstruction; and of additional information of the nature of the obstructive lesion. Surely this is a procedure which will add to the comfort of the patient, to the ease of the operation, and to a substantial reduction in the morbidity and mortality of conditions causing obstruction of the intestinal tract. Not only will it permit of operation, when gangrene is not expected, at a time when this can best be done, but it will still further reduce the incidence of jejunostomies, ileostomies, and colostomies, for it will equally well keep the bowel empty during the critical period subsequent to operation.

The development of this method is another example of the way in which fundamental studies eventually aid the practice of medicine and surgery, for T. Grier Miller originally devised the two-lumen tube for studies of intestinal secretions in man. The science and practice of medicine are thus drawn together.

In the present communication, only a few of the recent contributions to surgical therapeusis have been discussed; much might have been added on a number of other interesting and important subjects. Vaccination of the peritoneum should be receiving widespread attention at present and is a fertile field for discussion and speculation. The recent advances in chemotherapy form a brilliant chapter in therapeusis. Sulfanilamide therapy in hemolytic streptococcal and colon bacillus infections is having a profound influence on surgical practice, and sulphapyridine therapy in pneumococcic infections may well influence the incidence of empyema following pneumococcic pneumonia.

It is of greatest importance that we as surgeons be constantly familiar with new developments in our fields, that we evaluate them promptly and if found of value add them to the procedures already available. Only in this way can surgery remain dynamic and be of constantly increasing importance in the science of medicine.

SURGERY OF THE GALLBLADDER

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IT IS difficult to understand how such gross pathologic changes as are associated with diseases of the gallbladder should have gone so long unrecognized. Hippocrates records no knowledge of gallstones, and Galen is said not to have been aware of the source of biliary calculi which he observed to pass from the rectum. The earliest mention in the literature of any operation being performed upon the gallbladder is a reference by Thudichum to the fact that Fabricius Hildanus testified that Johann Fabricius, in 1618, removed stones from a human gallbladder. Theophilus Roth,[1] in writing the story of surgery of the gallbladder, in 1885, stated that he had consulted the original source of this information and was convinced that this operation was in reality performed upon a cadaver.

It is an interesting fact that operations upon the human gallbladder were preceded by experimental work in which operations similar to those subsequently performed upon humans were carried out upon animals. Zambeccari,[2] an Italian, in 1630, reported the successful extirpation of the gallbladder of a dog. Tecop, of Leiden, in 1667, is reported to have performed experiments upon dogs which led him to the conclusion that the gallbladder of a dog can be removed without danger to life or health. Etmuller, of Leipzig, carried out a series of experiments to determine if it were possible to dissolve gallstones during life. His experiments failed, and he concluded that the removal of gallstones lies only in the field of surgery. Experiments were also carried out by Malpighi, Taubrin, Bohn, Verheye and Seeger.

There seems to be little doubt that the first to perform a premeditated operation upon the gallbladder was J. L. Petit,[3] in 1743. Petit, however, limited his operations to those cases in which the gallbladder was adherent to the abdominal wall and could be opened without entering the general peritoneal cavity. This fact discloses a remarkable appreciation of general peritonitis, long before the days of any knowledge concerning bacteria.

Bloch,[4] of Berlin, in 1874, reported an attempt to produce artificial adhesions of the gallbladder to the abdominal wall by the application of various escharotics, in order that the gallbladder might be subsequently incised without entering the general peritoneal cavity. In 1859, Thudichum[5] recommended the two stage cholecystostomy, in which the abdomen was opened and the gallbladder sutured into the abdominal wound, to be subsequently opened for the removal of stones. In spite of Thudichum's recommendation, however, it was not until June 15, 1867, that John S. Bobbs,[6] of Indianapolis, Indiana,

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actually performed the first operation upon the gallbladder after the opening of the general peritoneal cavity. It is true that the Bobbs operation was undertaken without a preoperative diagnosis of gallbladder disease, but as Tinker[20] states, if Bobbs were to be deprived of the honor of priority on this ground, we would also by the same logic have to deprive Columbus of the credit for the discovery of America.

The patient who was operated upon by Bobbs was a woman, age 30, who for a period of four years had noticed the enlargement in the right side of the abdomen. On examination the tumor was tender, slightly movable, and a diagnosis of probable ovarian cyst was made. The abdomen was opened and a large cystic tumor was found. The cyst was opened and found to contain clear fluid and several "gallstones" about the size of ordinary bullets. The incisions in the gallbladder and abdominal wall were then closed by sutures and the patient made an uneventful recovery. She was found by Tinker[20] to be still living, but not entirely well, 32 years after operation.

Apparently without knowledge of the Bobbs operation, J. Marion Sims performed the first premeditated one stage operative procedure upon the nonadherent gallbladder, April 18, 1878. The operation was performed upon a jaundiced woman, and although the operation upon the gallbladder seems to have been successfully performed, the patient died, presumably because of stone in the common bile duct. At any rate, Sims was unable to find any evidence of peritonitis and attributed the immediate success of the operation to the careful use of antiseptic methods then so recently introduced.

The third operation upon the gallbladder was performed by Theodore Kocher in June, 1878. In this operation the patient was also a woman, age 30, who was thought to have an ovarian tumor. The abdomen was opened, a distended gallbladder discovered, a piece of "Lister gauze" was laid over the distended gallbladder and the edges of the wound were packed apart. Seven days later the gallbladder was incised and the stones removed. The patient recovered.

The fourth operation upon the gallbladder was performed, November 4, 1878, by W. W. Keen.[9] The operation performed by Keen was similar to that previously performed by Sims. The patient died 36 hours after operation from hemorrhage, exhaustion and shock. A diagnosis of obstruction of the biliary passages had been made previous to operation from results of aspiration of the distended gallbladder.

The fifth operation was performed by Lawson Tait,[10] August 23, 1879. This patient was a woman, age 40, with a history of gallstones for one year. At operation the gallbladder was opened, the stones removed and a fistula established by sewing the opened gallbladder into the abdominal wound. The patient recovered.

The sixth operation was performed, July 15, 1882, by Carl Langenbuch,[11] of Berlin. The patient was a male, age 43, who had had a history of biliary colic for six years previous to operation. At operation the abdomen was opened and the gallbladder entirely removed.

The seventh operation was performed by Ransohoff,[12] of Cincinnati, May 3, 1883. In this case the operation performed was similar to that first performed by Sims, but the operation is of very great interest historically because it is presumably the first patient who was ever operated upon in which it was *known* previous to opening the abdomen that stones were present in the gallbladder. These stones could be definitely felt with the trocar which was used for aspirating the gallbladder previous to operation, and thus roentgenologic visualization and cholecystography were anticipated by Ransohoff with his trocar.

As far as priority is concerned, therefore, the first operation upon the gallbladder was a lithotomy performed by Bobbs, in 1867; the first premeditated operation upon the gallbladder was a cholecystostomy performed by Sims, in 1878; the first successful premeditated operation upon the gallbladder was a two stage cholecystostomy performed by Kocher, in 1878; the first cholecystectomy, which was also successful, was performed by Langenbuch, in 1882; and the first successful premeditated single stage operation, in which the presence of stones was definitely known before operation, was performed by Ransohoff, in 1883.

The first publication which dealt in any way in a comprehensive manner with surgery of the gallbladder was by Musser and Keen,[13] in 1884. At this time they were able to collect from the world's literature 31 cases in which operation had been performed upon the gallbladder. Eighteen of these operations had been performed by Lawson Tait and two by W. W. Keen. It is interesting to note that one-third of the operations which had been performed by Lawson Tait were cholecystectomies.

It is of great interest to note that Musser and Keen, in reporting the operation and subsequent autopsy upon one of these early cases operated upon for gallbladder disease, stated that both operation and autopsy were attended by a student of medicine, a certain Mr. Dock. I communicated with Dr. George Dock of Pasadena, California, and asked him if he happened to be this inquisitive medical student. Doctor Dock replied in the following letter:

"Dear Dr. Brooks:—Yours of February 28, 1938, was read with much pleasure. I wonder if you are really as much interested in surgery of the gallbladder as I was more than 50 years ago. I have not read the article of Musser and Keen recently, but I was the nurse on the case, for it was before the days of trained nurses. The operation was performed too late, through no fault of ours. Dr. Keen was just as perfect an operator at that time as he demonstrated later, and was unusually competent for the after-care of surgical patients. At that date Keen was said to have the largest general practice in Philadelphia. He was also known as the fastest and most reckless driver in that city, and I have often gone around the corner in his buggy on two wheels. I should say that I subsequently became his surgical intern and he always continued his kindly interest in me.

"My teacher, John H. Musser, discovered the case and knowing Keen's work, asked him to be the operator. Hughes (who performed the autopsy) was commonly known as Billy and was considered the brightest young internist of his time.

"The work of collecting and working up the literature concerning surgery of the gallbladder at that time was handed over to me with the understanding that Musser and

Keen were to use the material for a publication, but I was to make use of the material for writing my thesis. Accordingly, the latter was never published but is still preserved in the University of Pennsylvania Medical Library.

"With the assistance of Perry Fisher, of the College of Physicians, and of the Surgeon General's Library, I think we missed very little in the literature. On account of the primitive indexing, it was quite a task. Among other things, in those days the Index Medicus listed not only the titles of original articles, but all abstracts of these articles. In the case of Marion Sims there were many references to his report under the name of J. M. Luis, evidently a mistake through longhand writing. We must have had at least a dozen volumes of articles under the name of Luis, in various languages, on all of which we had to pay express from Washington and return.

"One incident of the operation is interesting: J. M. DaCosta, at that time the ranking medical consultant in Philadelphia, had once seen the patient and accordingly he was invited to the operation and accepted. The operation was performed at the patient's house and DaCosta was ushered into the parlor. When Keen had the abdomen opened he asked me to tell DaCosta the operation was beginning. DaCosta thanked me and said: 'I care not for surgery.'"

This communication from Dr. George Dock is not only of interest in depicting the early days of surgery of the gallbladder, but it brings to our minds with great force the extreme youth of a therapeutic measure which is so widely used at the present time.

In this first publication dealing with the surgery of the gallbladder, Musser and Keen discussed, in much the same words as occur in the literature of to-day, the problems involved. The greatest difference, after all, lies in the last paragraph in which Keen states: "Finally, while loath to differ from one who has had as large and as successful an experience as Mr. Tait, we are still firmly convinced that strict antiseptic precautions and methods should be used in this as well as in all other abdominal sections." This statement is of particular interest in revealing the time at which Mr. Tait began his vigorous opposition to antiseptic methods, for in presenting a paper to the Royal Medical and Chirurgical Society in May, 1879, Mr. Tait states very definitely that the antiseptic technic was being employed by him in operations upon the gallbladder. Mr. Tait stated that he was following the practice, not because it was proved to be the cause of success but that he might not reproach himself for leaving any stone unturned for the good of his patients.

The terminology employed in the description of early operations upon the gallbladder is of considerable interest. Doctor Bobbs named his operation lithotomy of the gallbladder. Sims coined the word cholecystotomy from the three Greek words meaning gall, bladder, and incision. He stated that it was not necessary to include "laparo" in the name because the gallbladder could not be reached in any other way than through the abdominal wall. The term cholecystotomy as used by Sims and his successors, for at least a period of 20 years, was used analogously to the term ovariotomy and implied cutting for the gallbladder rather than cutting the gallbladder itself. The term cholecystectomy was applied in the first operation of this nature. However, in the early descriptions, operations upon the gallbladder were referred to as cystostomy, cystectomy, cholecystotomy and ideal cholecystotomy. The

term cholecystostomy does not appear frequently in the indices of the various surgical journals until after 1900. If one were not aware of the difference in terminology of operations upon the gallbladder 50 years ago and at the present time, he would overlook in the early literature numerous reports of gallbladder operations.

Following the report of Musser and Keen, in 1884, reports of operations upon the gallbladder increased with great rapidity, and the discussion was changed from the center of interest of the propriety of operations upon the gallbladder to an interest in the type of operation performed. From the beginning there was frequently expressed a difference of opinion as to whether the gallbladder should be removed or whether some sort of operation should be carried out, the result of which was the removal of the stones and the establishment of drainage. The method of cholecystectomy was practically the same in the first case operated upon by Carl Langenbuch, in 1882, as that which is used to-day. That is, if one does not attribute great importance as to whether the gallbladder is removed by beginning at the fundus or by beginning at the ampulla. There has been, however, an enormous amount of attention given to the numerous methods of operations upon the gallbladder associated with the establishment of drainage. It is an interesting fact that among the first 31 cases collected by Keen was one in which a very complex operative procedure had been carried out by Winiwarter, the end-result of which was the establishment of drainage between the fundus of the gallbladder and a loop of small intestine. In this operation Winiwarter anticipated our present cholecystogastrostomy or cholecysto-enterostomy for irreparable common duct obstruction. The generally accepted technic, however, for the drainage of the gallbladder was that which was practiced by Sims in the first operation upon the gallbladder in which the open gallbladder was sutured in the abdominal wall, or in which the gallbladder was sutured into the abdominal wall and subsequently opened. This procedure was generally referred to as the production of a fistula, and there are numerous reports of the removal of gallstones for long periods after operation through the fistulous opening, as there are also records of patients in which the fistula refused to close because of obstruction of either the common or the cystic duct. Anyone who has had even small experience in surgery of the gallbladder could not escape the conclusion that the early operators must have had great difficulty in sewing anything other than a large distended gallbladder securely into the abdominal wound.

It is an interesting fact that Maurice Richardson,[14] in 1893, in speaking of the first operation which he performed upon the gallbladder, September 9, 1890, stated that the gallbladder was so contracted that he could not bring it into contact with the abdominal wall. A glass tube was placed in the remains of the gallbladder and brought out through the abdominal wall. The drainage was excellent and convalescence was soon established. Unfortunately the patient eventually died of sepsis from a retained gauze sponge. Richardson describes in detail his methods of securing drainage of the gallbladder in in-

stances in which it is not sufficiently large to sew into the abdominal wound. It is an interesting fact that Richardson, in 1893, still believed that the safest method of performing a cholecystostomy was by suturing the gallbladder into the abdominal wall, but he had found from experience that if it were necessary to connect the gallbladder with the exterior of the abdominal wall by a tube, that a rubber tube was preferable to glass.

Poppert,[15] of Giessen, reported to the German Surgical Society in 1898 a method of cholecystotomy with water-tight drainage which subsequently was adopted as the technic of cholecystostomy throughout the world. It is of interest to note that in the description of his technic, Poppert repeatedly used the word cholecystotomy, but that in the index to the twenty-seventh volume of the Transactions of the German Surgical Society the paper is indexed as cholecystostomy. Poppert reports the satisfactory use of his method in 47 operations upon the gallbladder, and the increased frequency with which gallbladder operations were performed is illustrated by the fact that the same operator[16] reports the use of the method in 128 instances the following year.

After 1900, cholecystostomy of Poppert and cholecystectomy of Langenbuch became for the most part the routine operations of the world for inflammatory disease of the gallbladder. The relative frequency with which these operations were performed varied a great deal in different countries and in the different clinics of the same country. For example, Kehr,[17] in 1903, reports 720 celiotomies for gallbladder disease. It is interesting to note that the majority of the first 360 operations were cholecystostomies, while in the last 360 operations cholecystectomy was much more frequently performed.

In the discussion of the relative merits of the excision or drainage of the gallbladder for stones, it is interesting to note that in the beginning the major interest in the merits of these two operations lay in the question of their relative operative mortality; but in 1899, William J. Mayo[18] called attention to the fact that drainage of the gallbladder was not always effective in preventing recurrence of gallbladder symptoms, and at this time suggested the possibility of modified cholecystectomy in which only the mucous membrane of the gallbladder was removed. From 1900 to 1920, the relative operative mortality, the frequency of recurrence of gallstones after drainage of the gallbladder, and the possible deleterious effects of depriving an individual of a gallbladder, led to a great many debates on the subject of "cholecystectomy versus cholecystostomy": and without accurate statistics upon which to base the assertion, I believe I am safe in saying that cholecystostomy remained the routine operation for gallstones until approximately 1915, at which time there was a rather abrupt swing to the adoption of cholecystectomy as the routine operation in the larger surgical clinics for disease of the gallbladder. I have been much interested to find that in many rural communities in this country cholecystostomy remains the routine operation for the treatment of inflammatory disease of the gallbladder.

In 1924, interest in surgery of the gallbladder was tremendously increased by the introduction by Graham and Cole of the method now known as

cholecystography. Perhaps no other method of examination has been so quickly and so widely disseminated throughout the world; so that within a relatively short time, cholecystography became almost a routine method of examination of all patients entering the hospital with symptoms referable to the upper abdomen.

In review, therefore, it may be said that Doctor Bobbs, of Indianapolis, in 1867, initiated an interest in surgery which was far out of proportion to the security which this pioneer surgeon felt in his diagnosis or, indeed, in his knowledge of what he had actually done in the way of an operation. The operation of Doctor Bobbs, which, after all, consisted in opening the gallbladder, removal of the stones and subsequent closure of the gallbadder within the abdomen, although apparently never widely adopted as a method of dealing with gallstones, was subsequently redescribed as the operation of "ideal cholecystotomy" by Langenbuch, and was reported to the New York Surgical Society as having been performed by Willy Meyer as late as May, 1912.

It is also of great interest to note how the original idea, as put forth by J. L. Petit, in 1733, influenced the development of surgery of the gallbladder. The incorporation of the open gallbladder in the abdominal wound; the cholecystenterostomy of Winiwarter, subsequently modified by J. B. Murphy; the cholecystendysis of Courvoisier; and the two stage cholecystostomy of Kocher and its subsequent modification by Bloch are, after all, but methods of preventing the discharge of the contents of the gallbladder into the peritoneal cavity; and finally we have adopted the technic employed by Langenbuch in the sixth operation ever performed in the world upon the gallbladder as the method of choice in the treatment of all inflammatory diseases of this organ. The technic of operation upon the gallbladder has vastly improved, and one certainly has to admit that Doctor Graham's method of determining gallstones preoperatively, although not quite so direct, is at least less dangerous and less painful than that employed by Ransohoff, of Cincinnati, in 1883.

At this point it is interesting to recall the statement made by Lawson Tait concerning the original report of J. Marion Sims of the first cholecystostomy. Mr. Tait said more than 50 years ago: "The entire possibilities of treatment of gallstone and distended gallbladder are exhausted by Sims' paper." The fact that Mr. Tait spoke a bit extravagantly is shown by the large volume of literature dealing with this subject which has subsequently appeared, and particularly by the recent appearance of a number of papers concerning another question often previously raised but now being forced to the front, concerning the advisability of operating in the presence of acute cholecystitis.

With this background of the surgery of the gallbladder and this brief reference to at least one of its unsolved problems, I thought it would be of interest to review our own experience in the Vanderbilt University Hospital during a period of 12 years. During this time, 512 operations have been performed upon the gallbladder and bile ducts.

With relatively few exceptions, these patients have all been cared for

according to certain fairly definite rules. Most of the operations have been performed by me or by members of the staff under my direct supervision. A small number of the operations have been performed by members of the visiting staff, in whom there is no evident difference in ideas concerning surgery of the gallbladder. There have been no changes in policy during the period being investigated.

There has been a constant, studied endeavor to avoid if possible operations upon the gallbladder during the period of acute inflammation. Patients entering the hospital during a remission of symptoms have been kept in the wards for periods of two days to one week for examination and teaching demonstrations. Patients admitted during an acute attack have usually been kept in bed until the acute process has apparently subsided. In 15 instances operation was performed on the day of admission. As would be expected, opening of the abdomen in patients apparently in complete remission has occasionally shown a red gallbladder with some fibrinous exudate; and in a few cases of failure of the acute symptoms to disappear completely, operation has been undertaken before a complete disappearance of the acute inflammatory process.

The right paramedian incision has been used as the routine method of exposure of the gallbladder, and in most cases the gallbladder has been removed by separating it from the liver after ligation and division of the cystic duct and vessels. The common bile duct was opened only if the patient had symptoms of common duct obstruction or if the common duct appeared abnormal or the gallbladder contained stones and a dilated cystic duct.

In all but about 25 cases a small cigarette drain was placed in the bed of the gallbladder and brought out through a stab wound at the costal margin. At one time, in about 25 cases in which the field of operation was quite bloodless after removal of the gallbladder, the abdominal incision was closed without drainage. No bad results were observed, but the convalescence of these patients was not sufficiently different from those with small drains to justify the potential risk of bile being discharged into the peritoneal cavity, and closure without drainage was discontinued.

In this study of 512 cases, the hospital records, cholecystograms and all of the specimens which had been preserved in the surgical pathologic laboratory were examined. From letters and personal interviews it was possible to determine the present condition of all of the patients operated upon except 38, which could not be traced. In estimating the condition of the patients from one to 12 years after operation, only those who stated that they had been completely relieved of all symptoms existing previous to operation were recorded as well. All patients who stated that there was indigestion or who found it necessary to follow some sort of diet, but who were relieved of recurring attacks of abdominal pain, were recorded as improved. Patients who stated that they had received no improvement from the operation were recorded as unimproved, even though there had been no recurrence of "gallstone colic." In general, therefore, the recorded estimations of the beneficial

effects of the operative procedure are opinions entertained by the patients themselves.

No attempt will be made to discuss in detail the results obtained in any particular group of cases. This information is summarized in tables. The discussion will for the most part deal with those cases in which the disease and therapeutic methods were limited to the gallbladder.

TABLE I

PRIMARY CHOLECYSTECTOMY FOR DISEASE LIMITED TO THE GALLBLADDER

		Died in Hospital		Condition Known 1 to 12 Years Postoperative							
					Well		Improved		Not Impr.		
	Cases		Per Cent	Cases	Cases	Per Cent	Cases	Per Cent	Cases	Per Cent	Not Traced
Advanced gross pathologic changes in gallbladder *with stones* in gallbladder	124	6	4.8	108	87	80.6	18	16.6	3	2.8	10
Moderate gross pathologic changes in gallbladder *with stones* in gallbladder	119	1	0.8	114	83	72.8	28	24.6	3	2.6	4
Advanced or Moderate gross pathologic changes in gallbladder with *no stones* in gallbladder	60	2	3.3	51	36	70.6	13	25.4	2	4.0	7
Indefinite pathologic changes in gallbladder with *no stones* in gallbladder	48	0	0.0	43	29	67.4	8	18.6	6	14.0	5
Totals	351	9	2.6	316	235	74.4	67	21.2	14	4.4	26

In 351 instances, primary cholecystectomy was performed for disease apparently limited to the gallbladder. In other words, these patients were all operated upon for the first time for gallbladder disease and nothing other than cholecystectomy was done (the appendix was removed in such cases as it could be easily delivered into the upper abdominal incision). In 303 of these patients, the pathologic findings in the gallbladder seemed adequate explanation for the symptoms for which operation was undertaken. If these cases are subdivided into groups according to the severity of the pathologic changes in the gallbladder, the operative mortality, as might be expected, is parallel with the degree of pathologic change; but, contrary to expectation, the patient's estimation of the beneficial effects of the operation is also directly proportionate to the degree of the pathologic change in the gallbladder removed. It would seem as if patients with "early" disease of the gallbladder or patients who had a fairly normal gallbladder wall, with stones, should more likely be found well after operation than patients with advanced changes in the gallbladder wall with stones. That this is not the case may be due to the fact that the patient's estimation of the relief afforded is, after all, relative to the amount of discomfort before operation. It was interesting, nevertheless, to know that proportionately more patients with gallstones considered themselves completely well after operation if there were advanced changes in the gallbladder wall than if the gallbladder wall was thin and the symptoms presumably entirely due to the presence of stones.

The fallacy of depending solely on the patient's estimation of the beneficial effects of the operative procedure is illustrated by six cases suffering from recurrent attacks of gallbladder colic who had the gallbladder removed and still maintained that no beneficial effect had been experienced.

Particular attention was paid to the determination if the unsatisfactory result could be attributed to stones left in the common duct, but in only one instance was there any evidence of a stone having been overlooked in the common duct in this series of 243 patients who had cholecystectomy and whose gallbladder contained gallstones.

The group requiring special comment is that of 48 cases in which cholecystectomy was performed for gallbladder disease, but in which there were insufficient pathologic changes in the gallbladder to account for the patient's symptoms. Seventeen of these cases were operated upon without cholecystographic examination. Of the 31 cases having cholecystographic examination, 15 showed no shadow of the gallbladder and 16 showed shadows interpreted as diminished function. In reviewing the cholecystographic records of these cases, there are certainly a few instances in which another interpreter would have considered the shadow normal. It must of course be assumed that there were unrecorded facts which justified the undertaking of an operative procedure.

The small risk of removing a gallbladder showing little or no pathologic change is shown by the fact that all of these patients made uneventful recovery.

Forty-three of these cases were traced from one to 12 years after operation. Twenty-nine cases reported themselves as well and attributed their good health to the effect of the operation. Eight patients considered themselves improved and complained only of slight indigestion. Only six cases felt that they had not been benefited. Although a smaller proportion of these patients experienced relief of symptoms than those having obvious gross pathologic changes in the gallbladder, the fact that so many considered themselves well or improved is an illustration of the breadth of space which still separates the science and practice of medicine. Whether or not disagreeable symptoms may come from an alteration in the function of a gallbladder, without anatomic change, and if so, whether these symptoms can be relieved by extirpation of the gallbladder, are unsolved problems of gallbladder disease.

Mortality Incidence Following 351 Primary Cholecystectomies.—In this group of 351 primary cholecystectomies, nine patients died in the hospital. Three cases died on the third, fourth and fifth postoperative days with pneumonia. One patient, dying eight hours after operation, was found to have advanced myocardial degeneration, and there was a question as to whether the symptoms attributed to the gallbladder might not in reality have been of cardiac origin. Another death occurred in a patient, age 71, known to have advanced coronary disease, but in whom operation seemed imperative after a year's observation. He died on the ninth postoperative day, and

autopsy showed occlusion of the coronary artery. The sixth death occurred on the seventh postoperative day in a woman, age 45, who had marked hypertensive cardiac disease. The seventh death occurred in a very frail man, age 69, who was found at operation to have a swollen, red gallbladder covered with fibrin. He had been observed three days before operation and found to be without fever, leukocytosis or signs of acute cholecystitis. After operation there were persistent vomiting and distention of the abdomen. He died on the seventh postoperative day. The eighth death occurred in a man, age 45, who had been studied in the hospital for one month previous to operation. Cholecystectomy was easily accomplished. The patient showed marked elevation of temperature until his death on the third postoperative day. Permission for autopsy could not be obtained. The ninth death occurred in a man, age 37, who had an easy cholecystectomy and a smooth postoperative course until the seventh postoperative day, when he died suddenly, and autopsy showed a large embolus in the pulmonary artery. The origin of the embolus could not be found.

TABLE II

PRIMARY CHOLECYSTOSTOMY FOR DISEASE LIMITED TO THE GALLBLADDER

		Died in Hospital		Condition Known 1 to 12 Years Postoperative							
					Well		Improved		Not Impr.		
	Cases		Per Cent	Cases	Cases	Per Cent	Cases	Per Cent	Cases	Per Cent	Not Traced
Cholecystostomy in V. U. Hospital for disease limited to gallbladder	24	3	12.5	14	8	57.2	5	35.7	1	7.1	7
Previous cholecystostomy (4 to 24 years). Cholecystectomy in V. U. Hospital	12	0	0.0	9	5	55.6	3	33.3	1	11.1	3
Cholecystostomy followed by cholecystectomy	7	1	14.3	6	4	66.7	2	33.3	0	0.0	0
Cholecystostomy for acute pancreatitis	3	0	0.0	3	1	33.3	2	66.7	0	0.0	0
Cholecystostomy for inoperable obstruction of common duct	4	2	50.0	2	0	0.0	0	0.0	2	100.0	0
Cholecystostomy in presence of acute yellow atrophy of the liver	3	2	66.7	1	1	100.0	0	0.0	0	0.0	0
Cholecystostomy for catarrhal jaundice	1	0	0.0	1	1	100.0	0	0.0	0	0.0	0
Totals	54	8	14.8	36	20	55.6	12	33.3	4	11.1	10

Primary cholecystostomy was performed 31 times for disease limited to the gallbladder. In six cases, the simpler operation was performed because of the presence of other serious diseases such as advanced heart disease or severe diabetes, typhoid fever, fractured hip, *etc.* In these cases, operation was performed through a small incision directly over a distended gallbladder. In 24 instances, operation was limited to drainage of the gallbladder because of the severity of the inflammatory process present. In reviewing the records of these cases, there were seven in which it appears that chole-

cystectomy might have been the better procedure at the time the operation was performed. In four cases, removal of the gallbladder would have been coupled with great technical difficulties. In six cases, the gallbladder was not removed because of the severity of the inflammatory process due to perforation and abscess formation. In these cases, a careful review of the records indicates that in no instance did it appear that the condition in the gallbladder which prevented its removal developed because of a delay in operation after admission to the hospital. Four of these patients were operated upon within a few hours after admission, and in the two in which operation was delayed three and five days, the patients had the onset of the acute attack more than two weeks before admission to the hospital. In one patient, the simpler procedure was employed because of the rapid decline of blood pressure during the operation.

Seven patients having primary cholecystostomy in Vanderbilt University Hospital had subsequent cholecystectomies, and 12 cholecystectomies were performed upon patients having had cholecystostomies elsewhere two to 24 years previously.

It is interesting to note that in the 19 cases in which cholecystectomy was carried out after the failure of cholecystostomy to relieve the symptoms of gallbladder disease, that of ten cases known to have stones at the time of the first operation, six had gallstones recur in the gallbladder.

Mortality Incidence Following 31 Primary Cholecystostomies.—In this group of 31 patients having cholecystostomy for diseases limited to the gallbladder, there were four deaths. The first death occurred in a man, age 73, who had had the gallbladder drained 30 hours after the onset of an acute attack. Postoperative pneumonia was the cause of death on the eighth postoperative day. The second death occurred in a man, age 61, who was operated upon the day of admission to the hospital, three days after the onset of the acute attack. At operation the gallbladder was ruptured and there was extensive peritonitis. He died three days after simple cholecystostomy. The third death occurred in a woman, age 73, with grave aplastic anemia, who developed acute cholecystitis five days before admission. After observing the patient for six days, simple cholecystostomy was performed and the patient died on the third postoperative day. The fourth death occurred in a man, age 59, who had been ill six weeks previous to admission. After simple cholecystostomy there was a smooth convalescence. The patient returned to the hospital one month after discharge. Cholecystectomy was performed and the patient died suddenly on the eighth postoperative day of pulmonary embolism.

Twenty-nine operations were performed for stones in the common bile duct. In one of these cases, two operations were necessary for the removal of the stone because at the first operation after the stone was located it slipped up into the hepatic duct and could not be relocated.

In seven operations in which stones were removed from the common duct,

the gallbladder was drained. In six of these operations, the patient's condition was such that it seemed wisest to keep the operative procedure as simple as possible. Five of these were 63 to 79 years of age; one patient had bacterial endocarditis. In one instance, a young woman with many stones in the common duct and the gallbladder, in whom there was a great deal of cicatricial tissue about the common duct, the gallbladder was deliberately not removed, in expectation of its possibly being useful later as a means of relieving common duct obstruction.

TABLE III

OPERATIONS FOR STONE IN COMMON DUCT

		Died in Hospital		Condition Known 1 to 12 Years Postoperative							
					Well		Improved		Not Impr.		
	Cases		Per Cent	Cases	Cases	Per Cent	Cases	Per Cent	Cases	Per Cent	Not Traced
Cholecystectomy with removal of stones from common duct	15	3	20.0	12	6	50.0	4	33.3	2	16.7	0
Cholecystostomy with removal of stones from common duct	7	2	28.5	4	4	100.0	0	0.0	0	0.0	1
Removal of stones from common duct after previous cholecystectomy	6	0	0.0	6	6	100.0	0	0.0	0	0.0	0
Removal of stones from common duct and cholecystectomy after previous cholecystostomy	1	0	0.0	1	1	100.0	0	0.0	0	0.0	0
Totals	29	5	17.2	23	17	73.9	4	17.4	2	8.7	1

In all instances in which stones were removed from the common duct, the incision through which they were removed was carefully closed. A small rubber tube was anchored to the end of the continuous catgut stitch closing the common duct. In no instance has a tube been inserted in the common duct. In each of the five cases dying, marked sepsis was present at the time of operation.

TABLE IV

CHOLECYSTOGASTROSTOMY FOR TUMOR (?) OF THE HEAD OF PANCREAS

Died in hospital	3—(14.3%)
Died later	14—(66.7%)
Well (8, 6, 2 and 1 yr. postoperative)	4—(19.0%)
Total	21

Cholecystogastrostomy was performed 21 times for patients with marked jaundice, and hard mass palpable in the head of the pancreas, and a distended gallbladder. The fact that four of these patients are found to be definitely well from one to eight years after operation speaks for the value of this operative procedure, and emphasizes the importance of a surgeon's never giving too grave a prognosis in those patients only *presumed* to have carcinoma of the head of the pancreas.

TABLE V

COMMON DUCT INJURED IN PREVIOUS GALLBLADDER OPERATION

Well	1—(50%)
Improved	1—(50%)
Total	2

The fact that only two patients have been operated upon during a period of 12 years for previous injury to the common duct in the course of operation upon the gallbladder, is definite evidence of the improvement in the skill of the average surgeon.

In one of these instances the patient has remained entirely well for a period of nearly five years after transplantation of the proximal stump of the obliterated common duct into the superior aspect of the duodenum.

The other patient has remained quite comfortable for a period of three years with a T-tube which was placed in the proximal stump of the common duct and superior aspect of the duodenum.

Time does not permit of a detailed discussion of the 55 patients summarized in Table VI. Obviously the wisdom of cholecystectomy in some of these cases is open to question. It is interesting to note, however, that in 19 patients operated upon for disease of the appendix or duodenum, a diseased gallbladder was found and removed. Thus it seems that the removal of an obviously diseased gallbladder has become as much a part of a celiotomy as the removal of an appendix.

From this experience of 512 operations upon the gallbladder and biliary passages, in which the ultimate result has been determined in 92.6 per cent of the patients one to 12 years after operation, there have been both confirmation and reversal of opinions previously entertained concerning surgery of the gallbladder. It would appear that little doubt existed as to the superiority of the results obtained by cholecystectomy from those previously obtained by cholecystostomy, and that the former operation carried with it, in the average case, no more risk than the latter. It also seems unavoidable to conclude that there will continue to appear from time to time cases in which the simpler operation, although to be considered as a palliative one, is preferable. It is interesting to note, however, that relatively more cholecystostomies were performed during the first rather than during the last six years of the period included in this study. I am definitely of the opinion that at least a few of the patients having had cholecystostomy performed during the first half of the period would have had cholecystectomy during the last half.

Concerning the question recently raised as to the advisability of subjecting patients with gallbladder disease to emergency operations for fear of the development of gangrene or peritonitis, we can find little evidence to indicate the desirability of changing our previous practice. In only one patient, dying after operation for gallbladder disease, did it appear that death was the result of peritonitis spreading from an acutely inflamed gallbladder. During the

TABLE VI

GALLBLADDER OPERATIONS ASSOCIATED WITH OTHER ABDOMINAL CONDITIONS

		Died in Hospital		Condition Known 1 to 12 Years Postoperative							
				Well			Improved		Not Impr.		
	Cases	Cases	Per Cent	Cases	Cases	Per Cent	Cases	Per Cent	Cases	Per Cent	Not Traced
Operations for appendicitis. Appendix accounted for symptoms. Gallbladder also removed	10	0	0.0	10	6	60.0	3	30.0	1	10.0	0
Operations for general peritonitis. Gallbladder covered with fibrin, but not cause of peritonitis	2	2	100.0	2	0	0.0	0	0.0	0	0.0	0
Operations for duodenal ulcer. Gallbladder found diseased; removed	9	0	0.0	8	3	37.5	3	37.5	2	25.0	1
Exploratory celiotomy. Cholecystectomy. Abscess liver	2	2	100.0	2	0	0.0	0	0.0	0	0.0	0
Splenectomy plus diseased gallbladder	2	1	50.0	2	0	0.0	1	50.0	0	0.0	0
Cholecystectomy in presence of:											
Marked duodenitis or dilated duodenum	7	0	0.0	7	2	28.6	2	28.6	3	42.8	0
Cirrhosis of liver	5	1	20.0	5	0	0.0	0	0.0	4	80.0	0
Carcinoma of gallbladder	6	1	16.6	6	0	0.0	0	0.0	5	83.4	0
Acute or chronic pancreatitis	6	1	16.6	6	1	16.7	1	16.7	3	50.0	0
Aneurysm of hepatic artery	1	0	0.0	1	0	0.0	0	0.0	1	100.0	0
Sarcoma of rib (mistaken diagnosis)	1	0	0.0	1	0	0.0	0	0.0	1	100.0	0
Calcified aorta	1	0	0.0	1	0	0.0	0	0.0	1	100.0	0
Abdominal Hodgkin's disease	1	1	100.0	1	0	0.0	0	0.0	0	0.0	0
Jejunostomy for esophageal obstruction	1	1	100.0	1	0	0.0	0	0.0	0	0.0	0
Tuberculous peritonitis	1	0	0.0	1	0	0.0	1	100.0	0	0.0	0
Totals	55	10	18.2	54	12	22.2	11	20.4	21	38.9	1

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period of this study, there were approximately 1,800 autopsies performed on more than 60 per cent of all the patients dying in the Vanderbilt University Hospital. Careful examination of the autopsy records disclosed no instance in which any patient died without operation because of gangrene or peritonitis originating from an acutely inflamed gallbladder. I believe it is probably true that if a patient could be seen within a few hours after the onset of an acute attack of gallbladder disease, and diagnosis could be made with certainty, that emergency operative intervention might be indicated; but as a matter of fact, patients with gallbladder disease have in the great majority of instances already successfully survived many attacks and come into the surgical wards only after a sufficient amount of time has elapsed to make waiting for the acute attack to subside the safer plan of procedure.

Although 75 per cent of the patients having cholecystectomy for inflammatory disease limited to the gallbladder report themselves as completely relieved of all symptoms existing before operation, there remain a considerable number who report residual abdominal discomfort. Previous to this study I believed that a fully satisfactory result was more likely to follow extirpation of a gallbladder with gallstones when there were no advanced pathologic changes in the gallbladder wall. It was interesting to find that the facts revealed in this study were contrary to this opinion. Reference has already been made to the relatively large proportion of clinical cures which have followed extirpation of a gallbladder showing relatively little pathologic change. I also believed that patients having cholecystectomy for gallbladder disease could often be expected to have residual symptoms referable to the abdomen for a considerable period of time after operation, and then could be expected to be completely relieved. This supposition was attributed to the necessity of the compensatory changes in the common duct to make up for the absence of the function performed by the gallbladder. As a matter of fact, a somewhat larger proportion of patients operated upon for less than three years report themselves as entirely well than in those who had been operated upon for more than three years. It is of course difficult to evaluate the influence of the relative aging of the patients and the lapse of time since operation in the patients' estimation of the beneficial effects of operative procedure.

It is somewhat disturbing to find that the mortality resulting from operations upon the gallbladder has not greatly diminished during the past 40 years. For example, W. J. Mayo, in 1899, reported 64 operations for gallstones, with one death; and Mayo Robson (19) stated, in 1904, that in 281 cases operated upon for inflammatory disease of the gallbladder, there were only three deaths, or a mortality rate of 1.6 per cent. Kehr, in 1896, reported barely 1 per cent mortality in simple cholecystostomy, but a mortality rate of 58 per cent in complicated cases.

In this series of cases, the operative mortality in uncomplicated cases was approximately 2.5 per cent. It may be worth mentioning that the mortality rate during the last six years was considerably less than during the first six

years. In the last 245 cholecystectomies performed, there has not been a single death.

There is, after all, therefore, undoubtedly a diminution in the mortality rate in operations upon the gallbladder, but I am inclined to believe that a good many, particularly the younger surgeons of to-day, have a feeling that the mortality rate of operations such as those performed upon the gallbladder is tremendously less than it was 40 years ago. It is well, therefore, I believe, to keep clearly in mind that the greatest part of the safety in undertaking intra-abdominal operations such as these lies in the skill of the surgeon rather than in the accomplishments due to the vast amount of modern knowledge involving blood chemistry, water balance, carbohydrate reserve, *etc.*

And thus we find that in surgery of the gallbladder there has developed, within a period so short that men now living had an active part in its beginning, a therapeutic measure now applied to thousands with sufficient effectiveness to be recognized by Dublin and Lotka, along with advances in the treatment of tuberculosis and the prevention of infant mortality, as an important influence in the great increase during the past 50 years in life expectancy; and perhaps even more has been accomplished in the alleviation of pain and suffering during life.

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HEPATIC AND BILIARY TRACT DISEASE*

A REVIEW OF RECENT SIGNIFICANT ADVANCES

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PERHAPS the reason that biliary tract disease is proving an exception to the dictum that it takes 100 years for a new fact to get into a text-book and 25 years for an erroneous fact to be eliminated is that until very recently text-books contained almost nothing about it, certainly nothing about it as we understand it to-day. In The American Text-Book of Surgery,[1] for instance, edited by W. W. Keen, and first published in 1893, more attention is devoted to the causes of cholelithiasis, which are stated as tight lacing, high living and lack of exercise, rather than to the disease itself. The term cholecystitis is not even mentioned, and common duct obstruction is listed as the only indication for surgical therapy. Nor does the 1906 revision[1] improve the situation very much, though that is hardly to be wondered at; a survey of many modern texts would reveal, in the light of what is now known about biliary tract diseases, relatively the same paucity of data.

It is a far cry from such books to Christopher's Textbook of Surgery by American Authors,[2] let us say, in which the section on biliary tract disease was written by the late E. Starr Judd and his associates. The chapter significantly entitled "Cholecystitis, Cholelithiasis, Choledocholithiasis and Associated Diseases of the Liver" is so comprehensive a summary of the modern conception of biliary tract disease that we can do no better than to use it as a basis for our discussion.

Judd states that cholecystitis is not a disease of a single isolated structure—the gallbladder—but a disease which affects the whole biliary tree, and gives rise to profound pathologic and functional changes in the liver and the pancreas, and which is also capable of affecting remote structures and functions. The gallbladder may be the "mischief-maker" of the biliary system, but failures following its removal are chiefly due to cholangitis, hepatitis and pancreatitis. Surgery is indicated in many, though by no means all, cases of cholecystic disease and such surgery demands for success not only technical dexterity of the highest order, but also painstaking postoperative treatment, and a degree of surgical judgment exacted by few other pathologic states.

The development of pancreatic and other changes is one of the chief reasons for the growing conviction of the importance of earlier surgery for gallbladder disease than was formerly considered necessary. Heyd,[3] in a recent analysis of 557 cases, has particularly emphasized the dangers of acute or subacute

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pancreatitis, pointing out that this complication is always associated with a high operative mortality, particularly in males. He might have gone farther and said that there are few more important reasons for failure after operation; the patient in whom pancreatic changes are suspected to exist should always be given a very guarded prognosis.

Economic and social implications, according to Heyd, loom large in the mortality of biliary tract surgery because they are the underlying cause of much delayed surgery. His figures are conclusive. Among the 417 private patients, in the study just mentioned, there were 20 deaths, or 4.8 per cent, while among the 140 public hospital patients there were 19 deaths, or 13.5 per cent. The delayed effects of delayed surgery, if we may so express it, are quite as striking as the symptomatic failures and the immediate disasters. Thus Judd and Priestley,[4] in an analysis of 65 late deaths after gallbladder operations, state that cardiac disease and apoplexy were responsible for 45 per cent, whereas normally they would be responsible for not more than 20 per cent. Dublin's[5] studies, again, show on the whole a shorter life expectancy for all patients after biliary tract surgery, with the risk appreciably worse for individuals over 50 years of age, and very much worse for men than for women. There is an increasing emphasis, too, upon the importance of early surgery in cholelithiasis, to prevent the development of malignancy, which is reported[6] as associated with stones in from 70 to 100 per cent of all cases. In short, as we[7] ourselves wrote some years ago: "Since both the catastrophes and the poor results of operations on the gallbladder are due, in large part, to delay in the institution of surgery, there would seem to be no logic or reason for the prolonged nonsurgical treatment of cholecystic disease."

We added to that statement a warning against promiscuous surgery on insufficient indications, particularly on the indication of biliary dyspepsia. A similar warning has been uttered by many others, notably by Graham and Mackey[8] and by Kunath.[9] In the "stoneless" gallbladder, when pain is not a symptom, there is no question that surgery is of doubtful value, and may do actual harm. By statistical evidence, Kunath makes his point that cholecystectomy in such cases results in a greater morbidity, a higher postoperative mortality and only half as many cures, as well as the development of dyspeptic symptoms in a certain proportion of patients who were previously free from them. In such cases both the symptoms and the lack of relief after operation are to be explained on the "basis of physiologic changes or altered function." Nonsurgical treatment is, therefore, wiser and safer, except perhaps in the occasional case in which cholecystocholedochostomy, as devised by Pribram,[10] might be employed to prevent stasis. Certainly in this type of case cholecystectomy would seem indicated very infrequently.

Much of the recent literature on gallbladder disease is devoted to an animated and often caustic discussion of immediate versus delayed surgery in acute cholecystitis, with sound authorities on opposite sides of the debate. The chief argument in favor of immediate surgery is obviously that advanced by Harvey Stone,[11] that the most gifted of diagnosticians cannot tell when an

acute process will subside and when it will go on to perforation. That argument, by operative and autopsy evidence, is beyond refutation. On the other hand, as we[12] have previously pointed out, if the statistics of biliary surgery are made up on the basis of complicated and uncomplicated cases, and if the complicated cases are further classified into those in which complications developed before the surgeon saw the patient and those in which they developed under his eyes and were his responsibility, we doubt whether the latter classification would be very large.

Furthermore, the differences between the two schools of thought are more apparent than real. As several recent writers[13, 14] have pointed out, much of the confusion can be eliminated by an accurate definition of terms. One group of surgeons argue for immediate or emergency operation. A second group, who also call themselves advocates of immediate operation, actually observe the patient for from two to seven days, or longer, before determining upon their course. The third group advocate elective surgery, weeks or months after the acute condition has subsided. When the situation is studied in the light of these definitions, and when to the discussion is added the contention of practically every surgeon who has written on the subject, that no general rules can be made and each case must be handled on its individual merits, it is apparent that the ground for dispute is almost swept away.

Whether or not one accepts the new classification of gallbladder disease formulated by Andrews,[15] one must agree with his reasons for advancing it—that the present classification largely ignores clinical, bacteriologic and chemical considerations, and sweeps physiologic considerations entirely into the discard. His careful studies have verified the observations of many other authors, that infection plays no very important part in the problem, and his studies on the cystic duct are illuminating; by serial sections he was able to demonstrate a surprisingly complex arrangement of valves and folds, which makes him question whether the gallbladder can ever empty itself, and which also convinces him that changes in the patency of the cystic duct are far more important in the initiation of the cycle that culminates in stone formation than has hitherto been supposed.

The surgery of the bile ducts occupies a large part of the recent literature on biliary tract disease. Two phases are particularly emphasized—the repair of operative injuries and strictures, and exploration of the ducts in all cases of cholelithiasis unless there is absolute evidence that they are free from stones. Lahey's statistics[16] prove the latter point. Up to 1926, he had opened the common duct in 15 per cent of all cases and found stones in 8 per cent. Since 1926, he had explored it in 44 per cent of all cases and found stones in 18 per cent, which made him realize that previously he had, presumably, left calculi in one of every 10 patients upon whom he had operated. Lahey, Allen and Wallace,[17] and others, to obviate this mischance, advocate dilatation of the common duct and ampulla of Vater with Bakes' dilators, but Zollinger and his associates[18] have shown that even when this method is carefully employed, hemorrhage and trauma are likely to terminate in a degree of scarring and

contracture that makes the precaution scarcely worth the risk. The plan of cholangiography at the operating table, as advocated by Best and his associates,[16, 19] Payne[20] and Walters,[21] among others, seems equally as effective as dilatation, and far less dangerous.

Even under normal circumstances the location of the extrahepatic ducts makes their complete exposure impossible, and in obese patients, whose livers lie high and in whom edema, inflammation and adhesions may further complicate the situation, the simplest exploration offers great difficulties and risks, so that any method to eliminate unnecessary surgery upon the ducts would be welcome. We have used cholangiography as a preoperative measure in biliary fistulae, as well as after operation, when it is very helpful in determining the optimum time for the removal of the drainage tube. By this method persistent obstruction can be demonstrated, it can be determined whether overlooked stones, abnormal function of the sphincter of Oddi, or inflammatory thickening in the head of the pancreas is responsible, and studies of intraductal pressure can also be made. My personal studies confirm the findings of others,[22] that in certain types of cholecystic and choledochal disease such drugs as amyl nitrite and glyceryl trinitrate, which relieve spasm, are more logical as well as more effective than morphine, which actually increases the pain by raising the intraductal pressure.

In connection with cholangiography, Pribram, in 1935, introduced the use of ether to dissolve stones left in the common duct and papilla after operation. Actually he revived the method, for it is mentioned in the 1893 edition of Keen and White's text-book, where it is credited to Walker. Pribram is so impressed with the results that he now refrains from exploring the common duct in poor risk patients, thus reducing both the operating time and the necessary manipulations; he considers the method effective even when stones are embedded in the duct wall. The disappearance of the stones is checked by repeated cholangiography. On the basis of our own experience, we would emphasize the importance of using only small quantities of ether, not more than 2 or 3 cc., and of diluting it with alcohol; failure to observe these precautions in one of our cases produced an alarming state of shock. Probstein and Eckert,[23] on the basis of experimental studies, question the safety of ether in patients with liver damage, but our own experiences do not bear out their warning. We used the method in one patient whose liver function tests by the Quick method gave dangerously low values. He was a very poor risk, and acute pancreatitis as well as acute cholecystitis contraindicated any surgery other than cholecystostomy. The use of the ether caused no disturbance and his liver function by the Quick test was almost normal at the time he was discharged.

Ravdin and his associates[24] have devised an ingenious apparatus for gradual decompression of the gallbladder. The regulation of the daily bile drainage protects the patient against the asthenia likely to follow prolonged loss of bile salts, and also eliminates the necessity of adding them to his diet or refeeding him his own bile. Ravdin's reasoning in this connection is similar to that

we employed in advocating gradual decompression two or three years ago—that the intensive hyperemia which occurs in the liver when complete obstruction is suddenly released may put such a strain upon an already damaged organ that fatal consequences may ensue.

Payne[25] in an excellent summary of postoperative care, has emphasized one or two simple precautions which are frequently overlooked. He advocates continuous gastric decompression after operation, to prevent postoperative vomiting, which he considers a frequent cause of hemorrhage from the cystic vessels and of bile-spill from the cystic and common ducts. He also points out the importance of chemical studies of the bile to determine the duration of common duct drainage. Coughlin[26] advises suture of the falciform ligament to the hepatoduodenal ligament and gastrocolic omentum, followed by postural drainage, to forestall peritonitis, which still accounts for 15 per cent or more of all deaths after biliary surgery. The good results which he has obtained by this simple measure warrant its more general employment.

We are in entire accord with Judd's statement that the substitution of cholecystectomy for cholecystostomy, except upon clearly defined indications, would result in the greatest single reduction in the number of secondary operations required in biliary surgery. His statistics, to the effect that approximately 50 per cent of all cholecystostomies, approximately half of which necessitate secondary operations, give highly unsatisfactory results, can be corroborated by any surgeon who investigates his results statistically and does not merely state his impressions. There can be no doubt that cholecystostomy is definitely indicated under certain circumstances. Judd outlines them clearly. It is indicated when the disease is very acute; when local technical difficulties make cholecystectomy hazardous or impossible in the hands of a skilled—not of an occasional—surgeon; when the general condition of the patient contraindicates any but the briefest procedure; when the relief of jaundice in common duct obstruction is the first consideration; or when the character of the obstruction is such that a secondary short-circuiting operation seems inevitable. Cholecystostomy may seem at the moment simple and expedient, the immediate mortality may be the same as the mortality of cholecystectomy, or perhaps lower, but when the number of secondary operations, and the mortality associated with them, is taken into consideration, the picture is by no means as bright. Dublin's statistics are very significant: According to the Metropolitan Life Insurance records, the late mortality after cholecystectomy was 95.9 per cent of the expected rate, whereas, after cholecystostomy, it was 155.7 per cent.

In spite of the general dissatisfaction with the present classification of jaundice into the obstructive or mechanical group and the nonobstructive group, which includes toxic, infectious and hemolytic jaundice, the pathogenetic classification published by Rich,[27] in 1930, has received singularly little attention. On the ground that jaundice will occur whenever there is a disturbance of balance between the amount of bilirubin delivered to the liver

for excretion and the capacity of the liver to excrete the pigment, he makes two main classifications, the retention type and the regurgitant type.

In the retention type of jaundice, the bilirubin circulating in the blood stream accumulates in the blood because it is not entirely excreted by the liver. It is bound in some way, perhaps to the plasma proteins, it gives an indirect van den Bergh reaction, and it does not pass through the kidneys into the urine. This type is associated with the milder forms of liver injury, chiefly cloudy swelling or cell atrophy, and it is caused partly by an increased formation of bilirubin and partly by a depressed excretory function of the liver, such as is caused by anoxemia and fever. It is, therefore, a secondary complication of such diseases as hemolytic anemia, congestive heart failure and lobar pneumonia.

In the regurgitant type of jaundice, the bilirubin is excreted by the liver cells, and then, by rupture of the bile canaliculi, escapes into the tissue spaces and blood sinusoids of the liver, by reason of obstruction of the larger bile ducts or necrosis of the liver cells. Bilirubin as well as whole bile escapes into the blood stream, the bile pigment is not bound, there is a direct van den Bergh reaction, and the pigment is excreted by the kidneys into the urine. This type of jaundice accompanies the major hepatic disorders. It is clear that careful observation of bile pigments in the tissues, the urine and the intestinal tract, and laboratory studies of the qualitative and quantitative relationships of the bilirubin in the blood will establish the variety of jaundice with which one is dealing.

Many methods have been suggested for the differential diagnosis of the different varieties of jaundice. Jacobi,[28] employing the glucose tolerance test, noted that in the obstructive variety of jaundice the curve was still elevated at the end of two hours, whereas in the nonobstructive variety there was a prompt fall after the initial rise. In repetitions[29] of the test after treatment for two or three weeks with liver extract, a high carbohydrate diet, and large quantities of glucose, he noted that in malignant disease the curve remained elevated at the end of two hours, as in the first test, whereas in benign disease it assumed the character of the toxic curve and fell sharply.

Carr and Foote[30] advocate cholecystography for the diagnosis of obstructive jaundice. They administered the dye intravenously, with glucose, in divided doses, and found that, when so given, it is excreted by the liver, even when the common duct is completely blocked, and remains radiopaque in the gallbladder for as long as a week. If the obstruction is intrahepatic, on the other hand, the gallbladder is not visualized at the end of 48 hours and the ductal system cannot be seen.

On the basis of Quick's[32] conception of a prothrombin deficiency as the explanation of the hemorrhagic diathesis, Snell and his associates at The Mayo Clinic[31] review some of the experimental work which has been going on for several years by Dam, Almquist and his associates, Hawkins and Brinkhous and others, and supply an excellent bibliography. According to this evidence, the prothrombin deficiency is due to a failure to absorb or a failure to utilize

some substance normally present in the diet which requires bile for its absorption. This substance, vitamin K, may also be depleted by such toxic factors as sweet clover disease or hepatic necrosis caused by chloroform. The experimental evidence is very convincing, as are the clinical results reported in 18 patients. In the cases in which an elevation of prothrombin time had demonstrated a bleeding tendency, the use of massive doses of vitamin K, in the form of prepared fish meal, reduced it to normal limits. The vitamin must be administered in bile salts; indeed, the administration of bile alone to an individual on a normal diet resulted in the same drop in the prothrombin time, although the administration of vitamin K when bile was absent from the intestinal tract was without effect. The importance of this experimental and clinical work can scarcely be overestimated.

Magath's[31] caustic observation that Howell's theory of blood coagulation has been memorized without too much understanding ever since it was evolved in 1912, is richly deserved. Certainly a blind reliance upon it has prevented the general acceptance of Quick's brilliant work on a prothrombin deficiency as the causative factor in the hemorrhagic diathesis of jaundice. We accept this theory unquestioningly, just as we accept the accuracy of his test devised to demonstrate the deficiency. We do believe, however, that it is too complicated for general use; it requires a well equipped laboratory and a very skilful technician. We have, however, found no simpler test reliable, including the Ivy[33] test, in which the factor of capillary contraction is eliminated and the burden of controlling hemorrhage is put upon the factor of coagulation; the last patient on our service who exhibited a hemorrhagic diathesis, as proved by both operation and at autopsy, had a normal Ivy bleeding time.

In neither our experimental nor our clinical studies have we been able to duplicate the findings of Naffziger, Carr and Foote[34]—that the coagulation defect is caused by retention in the blood of certain organic sulphur compounds which are anticoagulants. But in the course of our studies with the Grote[35] test for sulphur compounds, we stumbled, quite by accident, upon a test[36] for bleeding which we have been using for some two years with increasing assurance of its accuracy.

The Grote test is performed with blood serum, and while we were waiting for it to be expressed from the blood collected from a patient who clinically indicated a hemorrhagic diathesis by the presence of purpuric spots and hemorrhages of the mucous membrane, we noted that the clot was peculiarly large and bulky and that a very small amount of serum was expressed from it. We immediately began to study the serum volume in a control series of 25 nonjaundiced subjects, who were normal by all clinical and laboratory tests, and we found that at the end of four hours it was always equivalent to 50 per cent of the blood volume. Observation of jaundiced patients showed that this ratio was maintained in some, but that in others, notably the patient whose frank purpura had furnished the clue, the serum volume was decidedly below the normal level. We therefore devised a serum volume index, which equals the serum volume of the patient studied over one-half of the volume of the

blood, preferably 3 cc., which is withdrawn for the test and which is kept at room temperature for four hours. We consider 1 the standard of normal, and regard indices below this level as progressively indicative of a tendency to hemorrhage. The improvement of the patient under appropriate therapy can be demonstrated by repeated tests. The simplicity of this test makes it practical for any observer under any circumstances, for nothing is needed for it but a syringe and a graduated tube. The only precaution is a routine blood count, to demonstrate a possible anemia, for which due correction must be made.

We have proved the accuracy of this test in more than 100 patients. An illustrative example was in the case of a white male, age 69, suffering from obstructive jaundice due to carcinoma of the pancreas, who had a serum volume index of 0.62, although there was no clinical evidence of a hemorrhagic tendency. Through some error he was scheduled for operation with, what we consider, an entirely inadequate preparation, and without a repetition of the test. The surgeon reported to us that the performance of cholecystogastrostomy was complicated by free oozing, and a repetition of the serum volume test the following day revealed an index of 0.66, practically what it had been originally. The patient lived five days. At autopsy, bloody, bile-stained fluid was found in the peritoneal cavity; the stomach was full of coffee-ground material and contained the type of soft, waxy clot which, as The Mayo Clinic observers have pointed out, is characteristically present in the anastomosed organ.

The defective clot, a study of which is indirectly a part of this serum volume test, can readily be explained on the basis of a prothrombin deficiency, because of which a smaller amount of fibrinogen is converted into fibrin. In place of a normal firm, retractile clot, there is found a bulky, fragile clot, which retracts very imperfectly because the fibrinogen has been incompletely converted into fibrin and the expression of serum is incomplete. The type of clot explains the character of the bleeding in these patients. It is not a free hemorrhage but a slow ooze, in which capillary bleeding plays a very important part; the clot prevents hemorrhage, but its porous character permits continued seepage. Simple observation of the clot will, therefore, furnish many helpful data in jaundiced patients who are suspected of a bleeding tendency.

The experimental work of Mann[37, 38, 39] and his associates at The Mayo Clinic has vastly increased our knowledge of hepatic physiology and pathology, and the tendency in some quarters to dismiss their researches as purely theoretical is to be deplored. They are of the highest importance from the clinical standpoint, and it is hard to comprehend the reasoning processes of those who do not so regard them.

Not the least significant of these studies is the repeated proof of the capacity of the liver to carry on its functions greatly in excess of normal needs, and of its ability to maintain those functions when there is left only a small amount of normal tissue with which to carry on. Indeed, as Mann well puts it, perhaps one of the reasons why the liver is so generally ignored is because of the efficiency with which it does its work under such adverse circumstances. Be this as it may, there is an increasing body of opinion to sup-

port our own idea that an estimate of liver function is fast becoming a sine qua non of all surgery, including even elective operations.

Such an estimate is by no means easy, partly because of the wide diversity of hepatic function, partly because of dissatisfaction with most of the tests which are now available. The simpler tests are insensitive or inaccurate, or both. The more reliable tests are too complicated for general use, or too expensive, or inapplicable to the subjects in whom they would be most useful, or actually dangerous, in that they require the use of agents which would put an additional insult upon an already damaged organ. No test is universally applicable, none is infallible, and none, we would emphasize, should be accepted as correct unless it is repeated or made serially. The neglect of this precaution may give rise to dangerously misleading results.

We have not personally used DeCourcy's[40, 41] suggestion that blood iodine studies be made in cholecystic disease, but his results are very interesting. He finds the iodine content of the blood markedly increased in cases of long-standing cholecystic disease and hepatic insufficiency, the normal of three to six micrograms per 100 cc. increasing from 13.6 in hydrops of the gallbladder to 2,090 micrograms in common duct stones. Under glucose therapy he was able to reduce the elevation in most cases to 100 micrograms or less, a level at which he is convinced that operation is safe. Experimental studies have confirmed his clinical work.

We[42] have personally found the Quick[43] hippuric acid test of the detoxifying function of the liver a simple, almost universally applicable test, the results of which, over a period of some two years, we have found accurate and reliable. The test is logically devised. The synthesis of hippuric acid, as Quick notes, is a process of detoxification, brought about by the conjugation of benzoic acid and glycine. There is no store of preformed glycine in the body, but the liver has a maximum hourly synthesis which cannot be increased in the absence of an exogenous supply. The rate of the synthesis of hippuric acid is, therefore, governed by the physiologic ability of the organ to produce glycine. This ability is adversely affected in certain types of liver damage, and the output of hippuric acid is proportionately decreased. The test is thus based upon a normal and very important physiologic process, it puts no strain upon the liver, and it requires no elaborate laboratory equipment and no skilled personnel for its performance. Quick[44] has recently devised an intravenous modification of the test, to be employed when oral administration of the benzoic acid is unwise or impossible, and a limited experience with it has impressed us with its value. Most of the publications[45, 46, 47, 48, 49] dealing with the Quick test are in accord with our conclusions—that its results are usually corroborated by operative and postmortem findings, and that it is of value in demonstrating latent hepatic damage before clinical signs are evident.

We have found that by the serial use of this test, it is possible to determine the patient's liver function when he is first seen, check its improvement under preoperative therapy, and follow its postoperative variations. The marked impairment of liver function immediately after operation is highly

significant. Except for the glucose administered before operation in poor and doubtful risk patients, and after operation in all biliary surgery, the postoperative drop would undoubtedly be far more marked, and in many cases might have far more serious consequences. As it is, the drop to almost a third of normal after common duct surgery, for instance, is an indication of the enormous reserve capacity of the liver, though how far that reserve extends we are not at this time prepared even to speculate.

The fall in function on the second day after cholecystostomy, when glucose is usually discontinued, as compared with the proportionate maintenance of the level in cholecystectomy and common duct surgery, in which it is continued for longer periods of time, is highly significant. The immediate postoperative drop is less marked in cholecystostomy than in other procedures for obvious reasons: The operation is simpler, involving less time and trauma than more radical procedures, and it is performed upon patients who, because they are known or suspected to be poor risks, are likely to be very well prepared. But the slow return to normal in these special cases suggests the doubtful wisdom of prolonged drainage of the biliary tract and supports our previous adverse criticism of cholecystostomy.

We had recently a very dramatic illustration of the correctness of this test: A female, age 29, gave a history of recurrent attacks typical of appendicitis. Cholecystitis was mentioned in the differential diagnosis but there was no reason to consider it seriously. Both the oral and intravenous Quick test revealed a liver function approximately 35 per cent below normal, which observation was disregarded, and the patient was submitted to no special preparation. At operation, however, the significance of the low value was revealed: The gallbladder was markedly diseased, and the liver was of the small, scarred type, against which Heyd[50] has issued repeated warnings. Cholecystectomy was performed without incident. Through some error, the Quick test was not repeated on the first day after operation, and it could not be made on the second day, as the patient was dying, with the type of exitus described by both Heyd and ourselves as a vasomotor collapse. Death occurred in 36 hours. Autopsy was not permitted, but the absence of any temperature elevation and of any physical signs, in spite of the most careful repeated examinations, seemed to eliminate infection, while repeated blood counts eliminated hemorrhage. In this case it seems entirely logical to place the responsibility for the catastrope upon the damaged liver.

A tragedy of this sort gives point to Graham's[51] warning—that the patient with a damaged liver presents a questionable risk not only for biliary surgery but for any surgery, no matter how trivial the procedure may seem. We[52] have suggested many times that an appreciation of this concept would mean that candidates for any sort of surgery must be studied from the standpoint of hepatic function, and our use of the Quick test has more than once supported us in our contention. Most of the presumably normal subjects, whom we used as controls, exhibited normal preoperative values by this test, but at intervals we found unexpectedly low values, which repeated tests con-

firmed. Of course, not all such cases end disastrously, but at that we are now inclined to look very dubiously upon such patients unless they are carefully prepared for their surgical ordeal. Our control studies[53] show that even entirely normal subjects undergo a marked fall in liver function, regardless of the variety of anesthesia, when submitted to even such simple operations as elective appendicectomy or hernioplasty.

The effect of anesthesia on the liver is not, of course, new, but, except where chloroform is in question, the general tendency is to dismiss the risk very lightly. It cannot be so dismissed. A 21 per cent drop in liver function under ethylene, a 25 per cent drop under ether, a 49 per cent drop under spinal anesthesia, as our figures show, cannot be lightly waved away. Coleman's[54] recent study of 100 patients, submitted to operation under various types of anesthesia, differs in details from our study, but confirms our general statement that patients with damaged livers may undergo a dangerous postoperative drop in liver function, and that even normal subjects may suffer some impairment.

We[55, 56] have been particularly impressed with the results of the Quick test in thyroid disease, and have long associated ourselves with Lahey,[57] Dinsmore,[58] Frazier and his associates,[59, 60, 61] and with the other experienced thyroid surgeons who believe that the most common cause of thyroid storms and thyroid deaths is liver failure. It seems unreasonable to deny the relationship. The similarity of the clinical picture in thyroid crisis and liver death is well known, the corrective therapy is the same in both toxic thyroid and hepatic disease, and in both conditions there have repeatedly been noted at autopsy fatty infiltrative changes in the liver and actual necrosis of the liver cells.

Practically all the tests devised for liver function have been used, by those who appreciate the relationship, to estimate the risk of thyroid disease from the hepatic standpoint, but all of them have been found open to the disadvantages and objections we have already listed for them. The most recent suggestion, by Willard Bartlett, Jr.,[62, 63] that the Somogyi test for blood amylase be used for this purpose, came to our attention too late for us to use it personally; his own published results seem excellent, and in a recent personal communication he has informed us of his continued satisfaction with this test.

Our own results with the Quick hippuric acid test in thyroid disease are similar to those reported by Bartels[64] from Lahey's clinic, the only other comprehensive report of which we have knowledge. His statistics, like ours, show that the changes in liver function as revealed by this test are in accord with the clinical severity of the toxicity; that improvement under preoperative preparation can be checked by repetitions of the test; and that a postoperative decrease of function occurs in practically all cases, with a later return to approximately normal values. We would emphasize as strongly as we can that this test should not be assumed to tell more than it is supposed to tell. It interprets liver damage in terms of liver function, but a single test and repeated tests tell nothing more. In particular, the Quick test furnishes not the slightest indication of a possible cardiac risk.

The sharp postoperative drop noted in many cases is, we have no doubt, the explanation of many surgical deaths, particularly in improperly prepared patients, though again, because of the wide variations in our findings, we are unprepared to set any lower limit of safety. The marked postoperative fall was always offset in the toxic group, and usually in the nodular group, which is composed of older patients, by the use of glucose. In the simple diffuse type this measure was employed only on special indications, and there was usually nothing to bolster the postoperative fall, which seems, therefore, relatively more marked in this type of disease. The unexpectedly low values before operation in the nontoxic groups suggest that this test may reveal a latent toxicity, even when clinical manifestations are lacking. We have long suspected this situation to exist in many of our Negro patients, and the consistently lower values in our Negro cases support our belief.

We have used the Quick test in many other diseases and conditions, such as cirrhosis of the liver, Banti's disease, the toxemias of pregnancy, and similar states, finding both normal and abnormal values. Indeed, the frequent finding of normal values, even when liver impairment might reasonably have been expected, suggests a warning, particularly needed by the French writers,[65] that it is sometimes possible to lay too much stress on a presumed hepatic deficiency. Quick's introduction of the intravenous modification of the test now makes it possible to employ this method in intestinal obstruction, in which both clinical and experimental evidence of liver damage exists, but in which an oral test obviously cannot be employed.

Our studies with the Quick test have made it abundantly clear that the premises upon which glucose has been used to bolster liver function are entirely justified; the effects of its use and its withdrawal from the standpoint of liver function are plainly demonstrated by our figures.

In this connection, it should be said that Althausen's[66, 67] studies on glucose therapy deserve far more attention than they seem to have received. His clinical and experimental work shows that insulin is useless if not harmful in combination with glucose therapy, and also shows very strikingly that glucose by mouth is far more effective than glucose by vein. We are at present conducting a study which seems to prove this point. Ordinarily patients submitted to elective appendicectomy under ether anesthesia receive no special preparation, and undergo postoperatively, the Quick test shows an average drop of 25 per cent in liver function. We are now giving such patients glucose by mouth before and after operation. It is striking to note the decrease in the immediate postoperative drop in liver function, as compared with the series in which glucose was not given, and it is even more striking to note the values on the second postoperative day, when glucose can be taken freely by mouth; they are actually higher than the initial preoperative values. The advantages of glucose therapy in biliary and thyroid surgery have long been realized, and it might be the part of wisdom to employ this simple precaution routinely in all elective surgery on all normal subjects. We have secured equally striking results by a similar use of decholin (dehydrocholic acid).

Studies by Kramer and his associates[68] would seem to indicate that in the small number of cases in which patients fail to improve under glucose therapy, or do not respond to it at all, fatty infiltration of the liver may be responsible. In a recent series of experiments on exclusion of the pancreatic juice from the gastro-intestinal tract, we[69] have shown that the addition of lecithin to the diet will forestall such changes, and we propose to employ this method in the future on patients who do not respond to glucose therapy alone.

Another method of improving liver function after operation is the use of oxygen, as suggested by Judd,[70] to decrease anoxemia, a suggestion which the work of Ravdin and his associates[71] and of Shaw and his associates[72] has now put upon a rational basis. Transfusion, as demonstrated by Hawkins[73] and by Judd, has the same effect. Quick believes that in the hemorrhagic diathesis the beneficial effect of even small transfusions is to be explained by the replacement of prothrombin. This is not at variance with Judd's and Hawkins' studies, which show that transfusion improves the oxygen saturation curve of the blood.

We have obtained many good results with dehydrocholic acid, in the form of decholin, particularly after biliary surgery. It has been demonstrated[74, 75] that this is the least toxic of the bile salts, that it has a marked cholagogic action, and that its stimulation of the bile flow produces the effect of a physiologic lavage. Naturally it should not be used in the obstructive type of jaundice, in which an increased bile secretion could serve no useful purpose and might do much harm. The experimental observations of Schwiegk[76] are interesting in connection with our previous remarks concerning the improvement in the oxygen saturation curve of the blood after transfusion. He found that the intravenous injection of as little as 10 cc. of decholin almost doubled the pressure in the hepatic artery, but produced only a small rise in the portal pressure. His conclusion is that the first result of the injection is a hyperemia of the liver, associated with an increased provision of oxygen because of the increased flow of arterial blood; the next result is an increased choleresis of the liver cells. The explanation is entirely logical and bears out the very striking results we have secured with decholin in many cases, notably an increased bile drainage and an improved diuresis in several patients who were almost on the verge of uremic coma.

It is a curious fact that the work on autolytic peritonitis which has been published at intervals since Jackson[77] attacked the subject in 1909 is still regarded as useless experimentation by many surgeons. Yet in a sense they are not culpable, for in only a few of the many excellent contributions is there even a hint of a possible clinical application. Our own work[78] in this field leads us to take a precisely opposite view.

Our personal experiments prove conclusively that when liver, or any other tissue deprived of its blood supply, is implanted within the abdomen, the cause of death is the toxemia induced by products of autolysis, and that the rôle of the gas bacillus is secondary and catalytic. Contributing factors include the size and condition of the experimental animal, and the amount and form of

the implanted tissues, but we have shown that after due allowance for these factors the same results can be expected at longer or shorter intervals whether the tissue is whole or ground, adult or fetal, incubated or autoclaved. This is the conclusion of Andrews, Hrdina[79] and their associates, though the conclusion of Ellis and Dragstedt[80] is that a toxemia cannot result in the absence of bacterial growth in the necrotic tissue.

From the clinical aspect, we believe that the toxemia which exists in such pathologic states as intestinal obstruction, gangrenous appendicitis and trauma of various sorts is not the result of gas bacillus infection, as many have attempted to prove, but is the result of a true tissue autolysis; in all of these states the fundamental pathology lies in structures deprived of their blood supply, and the therapy is obvious: excision of the dying tissues.

We believe also that the experimental work done on autolytic peritonitis has a particular application to the problem of hepatic trauma. In a study of 54 such cases from the New Orleans Charity Hospital, we found the total mortality of 48 per cent curiously distributed. In stab wounds of the liver the death rate was 14.3 per cent (one of seven cases), in gunshot wounds it was 46.4 per cent (18 of 39 cases), and in rupture it was 87.5 per cent (seven of eight cases). In other words, as the extent of tissue destruction increased, so also did the mortality, which is exactly in accord with our theory that the amount of tissue necrosis is the thing that chiefly matters.

If our theory be correct, a very different concept must be developed in injuries of the liver. The old plan of hoping for the best must be discarded as unreasonable and dangerous, and immediate exploration is demanded in all cases in which it cannot be said positively that such injuries do not exist. Abrasions and minor injuries should be left untouched, to eliminate further trauma. Extensive lacerations should be sutured, and deep wounds should be sutured or packed according to the indications. The necessary trauma is unfortunate, but there is serious danger, even when bleeding seems to have ceased, that the hemorrhage may recur when the patient emerges from shock and a rising blood pressure may dislodge the clot. If there is extensive maceration of tissue, we take the position, we think for the first time, that resection is the safest plan, the risk of cutting into the liver being less, according to our theory, than the risk of absorption of toxins from the damaged tissue. We appreciate the serious implications in the advice, but Tinker's[81] extensive study of neoplasms of the liver shows that resection is perfectly feasible, and we are merely extending his indications.

We might say, in further support of our idea, that it seems significant that in the various cases of liver sequestration reported in the literature,[82] the patients who survived were those in whom the necrotic tissue was finally extruded or removed from the wound. It is something more than coincidence, too, that in no instance did improvement begin until the dying and dead tissue was eliminated from the body.

In the Charity Hospital series of liver injuries, seven patients died what we term a "liver death," a syndrome which has been materially clarified by the

observations of Helwig, Orr, Schutz and Kuhn.[83, 84] In one particularly striking case the clinical course after operation was at first smooth, but later uremic symptoms were apparent, profound jaundice developed, and the icteric index reached 210. Operation had revealed considerable destruction of hepatic tissue, and autopsy revealed typical degenerative changes in the liver, so extensive as to suggest acute yellow atrophy, and in the kidneys.

Controversy has raged around the subject of "liver deaths" and the liver-kidney syndrome since Heyd,[85] in 1924, first called attention to this type of exitus. We personally believe, on the basis of our own observations, that as a cause of death in biliary surgery this syndrome is second only to peritonitis. We also believe, as we have already intimated, that it can appear in other diseases and after other types of surgery. We are quite willing to grant the contention of Touroff[86] and of Colp and Ginzburg,[87] that in many cases in which autopsy has not been performed at all, or has been incomplete, the presumable diagnosis is untenable, but we also believe that in most cases the chain of evidence is too strong to be overlooked. It is significant of the interest which this syndrome has attracted that last year a Congress on Hepatic Insufficiency was held in France, the program of which included 130 papers. Yet we are repeatedly struck with the inclination of surgeons to deny the existence of this syndrome, and even to deride the possibility until it affects their own practice, when they pipe a very different tune. We cannot, however, go so far as Henschen and Clairmont,[88, 89] who state that: When hepatorenal insufficiency can be demonstrated before operation, surgery is contraindicated.

We ourselves[7] have been able to reproduce only the deferred or uremic type of liver death, and that only in two sets of experiments. In the first set of animals decompression of an artificially obstructed biliary tree was followed by death in from 72 to 96 hours. The symptoms included increasing listlessness, anorexia without gastro-intestinal symptoms, and oliguria which progressed rapidly to anuria. In five animals the nonprotein nitrogen of the blood rose from previously normal values to 72, 81, 93, 105 and 171 mg. In each case autopsy showed degenerative changes in the liver cells and in the convoluted tubules of the kidneys similar to the postmortem hepatic and renal lesions exhibited in the clinical cases.

In a second group of experiments, precisely similar clinical symptoms and postmortem hepatorenal changes followed the injection, by various routes, of saline and aqueous—though not of alcoholic—extracts made from the livers of patients who exhibited the clinical and postmortem picture of hyper-pyrexic "liver death" after biliary surgery. In our first experiments in this group, blood chemistry determinations are lacking because we did not then appreciate their significance. In later experiments, in which such studies were made, the nonprotein nitrogen of the blood rose from previously normal levels to a maximum of 181.8 mg. per 100 cc. Extracts of various strengths were used, and two of the dogs, in which weak extracts were used, recovered from their toxemia, and their elevated nonprotein nitrogen values dropped to normal. Postmortem findings in these dogs, which were sacrificed after their clinical

recovery, as well as in the dogs which died, showed changes in both the periportal area and the liver cells in the lobules. These changes ranged from cloudy swelling to degeneration. The kidneys exhibited degenerative changes in the convoluted tubules and mild hyperemia and avascular swelling of the glomeruli. All the changes, it will be noted, indicate the action of a powerful toxic agent.

The basis of these clinical and histologic findings is still far from clear. We[90] have shown in a series of personal experiments that the lining cells of the biliary ducts play no part in their production. Postmortem evidence is against the acceptance, except possibly in the occasional case, of Henschen's[88] theory of a persistence of the connection between the portal vein and the kidney, and also against his theory of the accidental ligation of the hepatic artery or its anomalously placed branches. Furthermore, we do not consider Sutton's[91] work on high temperature deaths after ligation of the hepatic artery entirely conclusive. For one thing, the temperatures of 104° and 105° F. which he reports are not unusually high for animals; in (unpublished) temperature studies on dogs subjected to hepatectomy, we have repeatedly noted preoperative temperatures as high as 103° F.

We explain the catastrophe on the conception, to use Henschen's excellent phrase, that these patients are "liver weaklings." They are able to endure the hepatic damage which they have suffered as long as they are subjected only to the stress and strain of ordinary life. They cannot, however, withstand the ordeal of anesthesia, the trauma of surgical manipulation, the drop in intra-abdominal temperature, the changes in hepatic and biliary pressure, and the other factors which biliary surgery introduces. Our studies with the Quick liver function test show how markedly liver function decreases in even normal patients after even simple surgery, and it is not difficult to picture what may happen in patients who begin with a handicap.

When liver function fails, the toxic substances which reach the liver in the course of normal body metabolism are thrown off undetoxified, and the kidney, in the line of physiologic duty, takes over the function of detoxification. It must deal not only with the undetoxified substances which the liver has been unable to handle but also, we postulate, with some specific toxic substance cast off by the necrosing hepatic cells. But in the kidney the margin of reserve is very slight, it promptly breaks down in its turn, and an overwhelming and lethal toxemia is the natural consequence. This theory is in accord with the theory of Helwig and his associates,[84] the only difference being that they argue a selective effect of the presumptive toxins upon the convoluted tubules of the kidney, while we believe that the kidney by normal physiologic processes takes over the detoxifying function of the liver when hepatic function fails. We personally have no doubt that hepatic damage always precedes renal damage and that prompt death with hyperpyrexic manifestations and deferred death with uremic manifestations are successive stages of the same pathologic process.

With considerable hesitation, we advance the theory that the type of "liver

death" which occasionally occurs within 30 to 36 hours after operation, with evidence of vasomotor collapse, may perhaps be explained on the basis of an anaphylactoid reaction. The patient, for hepatogenic or enterogenic reasons, may have become sensitive to the product of liver cell damage, a circumstance which becomes of extreme importance when, as happens at operation, the toxic substance is released into the circulation in massive doses. Then a true anaphylactoid reaction occurs, as manifested by a falling blood pressure, a falling temperature and a rising pulse rate. In ordinary surgical shock there is attempted compensation. The capacity of the vascular tree is decreased, for constriction of the arterioles compensates for the diminishing blood volume, and there are no manifestations of shock until compensation is broken. In anaphylactoid shock, however, there is no attempt at compensation because there is an immediate loss of tone through the whole vascular tree. Permeability changes follow, together with a loss of blood volume and the prompt development of the symptom-complex of shock, and death is the inevitable result.

There is some proof for this theory. Henschen has shown that in the dog the liver is the site of the occurrence of anaphylactoid shock and reasons by analogy that the same holds true in the human. He quotes Weil's experimental observations that in such circumstances the animal literally dies from loss of blood into the liver. We have shown in our (unpublished) experiments on animals subjected to hepatectomy that dogs sensitized with horse serum by the method of Gay[92] can tolerate, after hepatectomy, doses 150 times larger than the sensitizing dose. Such a dose before operation would have caused immediate death; after the liver was removed, it had no perceptible effect. To the not unreasonable objection that more patients should die this type of death if our reasoning were sound, we reply that it is conceivable that many patients are in a refractory state at operation. It is also conceivable that the toxin to which they are sensitive is not always produced in quantities sufficient to cause anaphylactoid shock.

We have never been able to satisfy ourselves that the relatively minor renal changes found at autopsy are sufficient to explain the extreme oliguria and anuria which these patients exhibit, though we agree with Jones[93] that the prognosis of hepatic disease of almost any sort can be predicated with remarkable accuracy on the presence or absence of spontaneous diuresis. These kidney changes, as Helwig and Schutz[94] have recently pointed out, are degenerative and not inflammatory. They are almost wholly confined to the tubular epithelium and the interstitial tissues, and there is no evidence of glomerular nephritis. It is tempting to accept the theory of Hans Meyer, quoted by Henschen, that the liver may furnish a urine-driving hormone, or the work of Glauback and Molitor, which Henschen also quotes, on the relief of anuria in experimental animals by the injection of a liver-extracted fraction, but the evidence is not conclusive.

The most convincing explanation is the one offered by Bruhl and Watzadse which is quoted by Vaccaro.[48] These authors found in their experimental work

on frogs that a lack of glycine brought about a cessation of glomerular circulation, and on this basis it seems not unreasonable to assume that the liver, by means of the amount of glycine released into the circulating blood stream, actually determines kidney function. If this be true, then we are justified in interpreting the progressive oliguria, passing over into anuria, which is the outstanding characteristic of the deferred liver-kidney syndrome, as due to a diminution of the glycine synthesis in the liver. The improvement in kidney function following the administration of dehydrocholic acid (decholin) which we have repeatedly noted, with the resulting improvement first in the synthesis of glycine and then in the formation of bile acids, would seem to support this view, quite aside from the testimony to such improvement supplied by observers who are entirely unsympathetic to our work.

Whatever be the cause, the practical application of the theory is that a patient who exhibits a diminished liver function before operation, as manifested by a failure of glycine synthesis, becomes a doubly poor risk if there are apparent also signs of kidney damage as manifested by a raised blood urea, a lowered urea clearance, and other evidences of kidney damage. Wilensky and Colp[95] made this point some years ago, when they suggested that renal deficiency should be considered an index of hepatic deficiency, and the improvement in liver function tests since that time has not lessened the value of their idea.

We are more and more convinced that in the liver, just as in the kidney, we must look for some explanation of the catastrophe of liver death beyond the morphologic changes in the liver cells. Garlock[96] reports a case in which the clinical picture was typical of the hepato-renal syndrome, but in which autopsy failed to reveal typical histologic findings or any reasonable cause of death. He mentions two similar cases studied some years before, in which it was finally decided that some profound physiologic or chemical change had taken place which could not be demonstrated by any known chemical or laboratory test. Nothing, he concludes, has since developed to throw light on the obscure picture.

It is undoubtedly true that all our clinical and experimental studies have advanced us little beyond that statement of futility. Our own idea is that in all of these cases, whether or not the clinical picture of hepatic insufficiency is supported by the morphologic evidence secured by autopsy, there is some functional intracellular hepatic derangement, with associated toxic and functional renal impairment. Our personal (unpublished) studies with chloroform and carbon tetrachloride necrosis of the liver furnish some support for this point of view.

But the outlook is far from hopeless. Enough work has been done on the liver-kidney syndrome to make us hopeful of ultimate success in the solution of its problems. Even now, proper estimate of the preoperative risk, adequate preoperative preparation, an operative procedure carefully calculated to correct the pathologic changes with the minimum of trauma, and intensive

postoperative therapy to bolster liver function, will do much to avoid such catastrophes.

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LARGE, CAVERNOUS HEMANGIOMATA OF THE LIVER*

REPORT OF AN INOPERABLE CASE TREATED WITH ROENTGENOTHERAPY

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HEMANGIOMATA of small size are not infrequently found in the liver at necropsy. Large hemangiomata of the liver are more unusual and, although usually benign, not infrequently produce symptoms from mechanical effects on the liver and neighboring structures. Because their existence as a source of the individual's symptoms and signs is often not anticipated, when exposed in the course of an exploratory celiotomy they certainly provide a wholly unexpected problem.

The present communication considers, briefly, the nature of these blood vessel tumors, mentions the experiences of other surgeons in attempting their removal, and finally, although the clinical material is limited to a single case, points out the value of an alternative therapeutic measure for those large and deeply embedded tumors in which excision is impossible or too hazardous.

ORIGIN AND DESCRIPTION.—Tumors of the blood vessels may perhaps be said to be as common as any form of neoplasm that occurs in the body. They are predominantly benign and exist most frequently over the body surfaces, where they offer mainly cosmetic problems. They may, however, be found in many of the organs of the body, particularly the liver. Geschickter and Keasbey[1] reviewed 570 cases of tumors of the blood vessels from the surgical and autopsy records of the Johns Hopkins Hospital, and found the distribution as follows: 370 peripheral angiomata (body surfaces and exposed mucous membranes); 135 central angiomata (109 in the liver and the remaining in heart valves and abdominal viscera); 65 angiomata in special locations (bone, muscle and central nervous system).

From the standpoint of the embryologic development of the vascular system, it may be expected that these tumors would be most frequently found in specific sites. The angioblast, anlage of primitive blood vessels, consists of cell masses which first appear in the splanchnic mesoderm of the body stalk and yolk sac. Here the primitive heart, aorta and sinusoids of the liver take root and the vascular system develops by extension, the peripheral capillary network forming from the channels which have extended into the subcutaneous tissues. It is reasonable to expect, therefore, that the greatest incidence of hemangiomata would follow the central and the peripheral growth-zones of the vascular system. This is the basis of the classification in the series of Geschickter and Keasbey.

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The cellular origin of hemangiomata has long been a subject of dispute. On the whole, the arguments favor a developmental anomaly in the structure of certain vascular segments which retain embryonal characters (Ewing[2]). Ribbert,[3] in discussing angiomata of the liver, contends that these growths are partial neoplasms originating from embryogenic disturbances through which a displaced segment comes to possess a limited power of aberrant growth.

Classification of hemangiomata has been variously attempted on the basis of clinical or pathologic characteristics. The most widely recognized forms are the capillary and the cavernous but, as Ewing points out, it is not always possible to distinguish clearly between the two. Nearly all agree that the hemangiomata of the liver are of the cavernous type.

Angiomata of the liver may be single or multiple, and may be limited to the liver or associated with angiomata elsewhere in the body. Most of them are small and symptomless but by slow growth their size may become excessive, even reaching "the size of a child's head" or greater. A limited number of these large tumors have been exposed at operation. An instance of exaggerated growth of a cavernous angioma of the liver is that reported by Major and Black,[4] in which at necropsy the liver tissue was found to be almost completely replaced by the angioma; the organ weighed 18,160 Gm. or 39.6 pounds, which comprised nearly one-half of the entire weight of the individual. The larger tumors have developed mostly in adults; a few have, however, been found in infants, thus suggesting a congenital origin.

Grossly, these tumors may be almost entirely embedded in the liver and present a variable soft, purplish elevation depending upon how superficial they are. On section, their appearance can be roughly compared to that of a sponge. Some exhibit a tendency to become pedunculated, a phenomenon, almost unquestionably, due to the drag of the tumor, and in a few, a narrow pedicle of blood vessels and attenuated liver parenchyma has resulted.

Under the microscope the endothelial-lined vascular channels are dilated and there are numerous papillary infoldings. Thin connective tissue septa are the rule, though, more rarely septa or islands of liver cells may separate the vascular spaces. At the edges of the tumor small vessels communicate with the sinuses and usually the parenchyma of the liver is well demarcated. Ribbert found that interstitial injections of the tumor or of the surrounding parenchyma did not pass from one tissue to the other, yet Virchow showed that the tumor may be filled by injections through the portal or hepatic veins or the hepatic artery (cited by Ewing).

Numerous reports of malignant vascular tumors are to be found in the literature, yet the exact nature of many of these is controversial. Interesting case histories of metastasizing hemangiomata have appeared sporadically. Recently Ward and Jonas[5] briefly reviewed the accounts of these tumors and reported their experience with a patient who had had a small cavernous hemangioma of the palm for many years which suddenly began to grow following

trauma. Several weeks after the removal of this well circumscribed tumor there was a local recurrence, and subsequently enlargement of the epitrochlear and axillary nodes. At autopsy, the local recurrence was found to be similar to the original tumor, in that it was histologically benign, yet the metastases found in the lymph nodes were histologically malignant. This case, and others, suggest that "peripheral" hemangiomata may suddenly develop malignant characteristics, and theoretically cavernous hemangiomata of the liver might do the same. However, there is less likelihood of trauma to the liver and, furthermore, the malignant hemangiomata of the liver, known as primary angiosarcomata, occur largely in infants and are invariably rapidly fatal.

Experience of Other Surgeons.—The therapeusis of large, benign cavernous hemangiomata of the liver has been of concern largely to the surgeon. In May, 1897, Doctor Keen[6] reported the successful removal of a large hepatic angioma and summarized the available accounts of resections of the liver up to that time. His patient was a housewife, age 53, with several years' history of recurring abdominal pain, digestive complaints and a palpable tumor in the upper abdomen of undetermined nature. At operation a solitary tumor of the liver was discovered which was recognized as an angioma. The tumor was estimated to be 7.5×6.5 cm. in size and most of it was embedded in the left lobe. He cut deeply into the liver around the tumor until an artificial pedicle, 5 cm. in width, was identified; the bleeding was controlled by packing in a collar of iodoform gauze and the pedicle was then encircled with two rubber bands. The bulk of the tumor was delivered extra-abdominally and the wound was partially closed. On the sixth postoperative day the rubber bands were removed and the pedicle divided. The exposed liver drained bile for several days and healing was slow but the patient eventually recovered.

Keen suggested that the concept of the previous decade, that the liver could not be resected because of hemorrhage, no longer obtained. In support of this attitude he cited 59 collected cases, including his own, in which the liver had been radically incised for removal of varying types of tumor, including gummata, secondary carcinomata, and echinococcus cysts; only four were alleged to be angiomata. He discussed at length the available methods for controlling hemorrhage in these procedures, mentioning elastic and nonelastic ligatures and such adjuvants as gauze packs, boiling water and the Paquelin cautery. There had been nine deaths in the series, seven from bleeding and two from infection, giving what was considered to be an acceptable mortality of 15.5 per cent. In the discussion that followed Keen's address his colleagues disclosed two instances of unreported fatal outcomes after resection of the liver, and suggested that not a few similar fatalities had occurred which had not come to general notice.

This, of course, in no way detracted from Keen's brilliant result or similar results obtained by such men of that era as von Eiselsberg, Doyen, Mayo-Robson and others. In 1898, Pfannenstiel[7] reported the complete

extirpation of what probably remains the largest hemangioma ever removed from the liver. Before partial evacuation of encysted blood it was estimated to weigh ten pounds, and even after loss of a large part of its fluid content actually weighed five pounds. Hemorrhage was excessive but the patient survived.

At intervals since then there have been reports of single cases and small series of large angiomata of the liver encountered at necropsy or at the operating table. The surgical reports have been concerned with two points: The successful extirpation of these growths and the accidents which have attended surgical interference. Numerous surgeons have showed great ingenuity in this type of surgery and some of the accounts afford absorbing reading. To cite one: Beck[8] exposed a large angioma with a short broad pedicle. He delivered the tumor outside the abdomen, placed an elastic ligature about its base and to hold the tumor in this extra-abdominal position transfixed the pedicle with hat pins supplied by the nursing staff. In due time the tumor and hat pins were removed and the patient recovered. More recently, Tinker[16] reviewed the whole subject of resection of the liver and urged that in the light of newer surgical methods, particularly electrosurgery, surgeons could be bolder in attacking hepatic tumors. At the same time he reported an interesting case of his own in which abdominal exploration of a patient having acute abdominal pain revealed an actively bleeding hemangioma of the liver; wide resection of the growth with the aid of a "cutting radiocurrent" was successfully carried out.

On the other hand, numerous accidents have served to emphasize the necessity for caution. Chiari[9] cited Freund who, while exploring an abdomen, accidentally ruptured a hepatic angioma with his finger and death from uncontrollable hemorrhage followed. Mantle[10] reports a case which at operation was found to have an angioma of such great size that its removal was deemed impossible. A needle puncture of the tumor to verify its nature resulted in profuse hemorrhage and death occurred within two hours. MacNaughton-Jones,[11] after what appeared to be a successful excision of a similar tumor, lost his patient from continued slow hemorrhage. McWeeney's[12] case, in which the surgeon cut directly into the angioma, only serves to illustrate what violent hemorrhage follows so incautious a maneuver.

Horsley[13] aptly pointed out that the only safe technic for excising a hepatic angioma that has no pedicle, is to carry the incision widely into normal liver substance and under no condition to cut into cavernous tissue or put a tenaculum or any sharp instrument into it. He feels that if this line of procedure cannot be adopted, excision must not be attempted. This appears to be a sound dictum.

It would be fortunate indeed if more of these tumors developed distinct pedicles. In Rubin's[14] case a tumor weighing nearly five pounds descended into the pelvis and was removed following ligature of the pedicle. Peck[15] successfully removed a pedunculated angioma by gradually transecting the

pedicle, step by step, with clamp and ligature. Recovery was complicated in his case by recurrent pulmonary emboli.

The above accounts are cited in some detail to emphasize that the surgical attack of angiomata of the liver is fraught with hazard; yet there can be little doubt that their removal is indicated if it can be accomplished without too great danger to the patient. Peck, in 1921, reviewed 21 operative cases in which the tumor was excised with 15 recoveries and two deaths, a mortality of 11.7 per cent. Even this percentage probably is far below the actual figures, if the true mortality for all surgical cases were known.

An alternative method of treatment, that is said to have been successfully employed in rare cases, had been the injection of the angioma with boiling water. This is intended to induce thrombosis, subsequent fibrosis and possibly obliteration of the tumor, but the procedure cannot be entirely safe for obvious reasons. One of the most efficacious methods we possess for producing obliterating fibrosis of blood vessels is roentgenotherapy. As illustration of its value in a large cavernous angioma of the liver, in which attempted excision appeared unwarranted, the following case is presented:

Case Report.—Hosp. No. 18947: A. deA., male, age 48, was admitted to the New York Hospital January 10, 1933, complaining of pain in the right side of his upper abdomen. He recalled no illness of importance in the past; he was married and had two normal children. Two and one-half years previously, he had gradually developed a vague pain in his upper abdomen, principally on the right side. He characterized it as a disagreeable pulling or dragging sensation which came and went without reason. The pain would last for hours at a time, while periods of freedom were often as long as a day. After several months of this the discomfort gradually diminished and for the next year and a half he was almost free of symptoms except for an occasional return of a dull discomfort at the end of a hard day.

Eight months before he came to the hospital his pain insidiously reappeared and increased to an unbearable degree. It was still primarily in the right hypochondrium but involved a larger area than before and occasionally extended into the periumbilical region. It did not radiate elsewhere. He described the pain as something more disagreeable than the former discomfort and said sometimes it felt as if it were tearing him. He was impressed that prolonged activity often induced or increased the pain while the recumbent position gave him relief. His belief that the pain bore some relationship to certain kinds of food could not be evaluated. He had had no nausea or vomiting nor had his appetite been impaired, yet he had lost 15 pounds in six months and complained of feeling generally weak. Moderate constipation had developed during this time.

Physical Examination showed him to be a healthy appearing and muscular individual. Aside from the abdominal findings there were no unusual physical features. The abdomen was slightly rounded but symmetrical. On palpation of the right upper quadrant there was voluntary splinting of the muscles and complaint of moderate tenderness. When partial relaxation was obtained a mass was felt 6 cm. below the right costal margin which, by palpation and percussion, seemed to be confluent with the liver. The edges were indistinct and motion on respiration could not be determined.

Laboratory Data: Blood counts, urine, stool, and blood serology were normal. Gastric acidity and glucose tolerance tests were found to be within the usual range. *Roentgenologic examination,* following a barium meal, showed the lesser curvature of the stomach to be displaced downward and to the left in a wide curve, apparently the result of pressure from an extragastric mass (Fig. 1a). This picture is most often indicative of a cyst of the body of the pancreas.

Operation.—February 3, 1933: Ethylene anesthesia. Through an upper, right rectus incision the abdominal cavity was exposed and there immediately presented a large, smoothly rounded tumor of deep plum color. Further exposure revealed it as a spheroidal

FIG. 1a.—January 23, 1933.

FIG. 1b.—March 8, 1938.

FIG. 1.—Comparative positions of the stomach. (a) Before treatment, and (b) five years after. Note the displacement of the lesser curvature by the tumor in (a), and the normal curvature in (b).

mass estimated to be 12x14 cm. and with over half of its bulk deeply embedded in the liver substance. A thin shell of hepatic tissue partly covered the margins of the bulging tumor. Palpation showed the tumor to be soft and compressible, and to have an alarm-

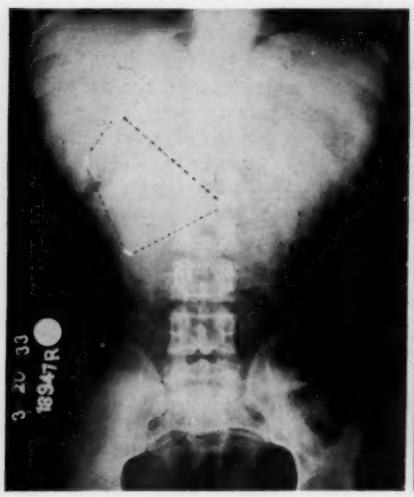

FIG. 2a.—March 20, 1933.

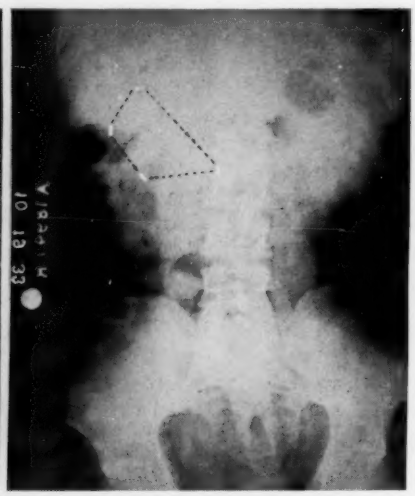

FIG. 2b.—October 19, 1933.

ingly thin capsule in places. Any thought of resection was abandoned because of the extensive procedure that would be required but, before closing the abdomen, four Cushing clips (silver) were pressed into the liver substance at intervals about the margin of the tumor. Postoperative recovery was uneventful.

Roentgenotherapy.—After a reasonable interval, to allow for recovery from operation, a roentgenogram of the abdomen was taken to determine the position of the silver clips. Then a course of roentgenotherapy was instituted. Alternating front and back and using from 300 to 370 R. units each time, treatments were given at suitable intervals during the

FIG. 2c.—May 3, 1934.

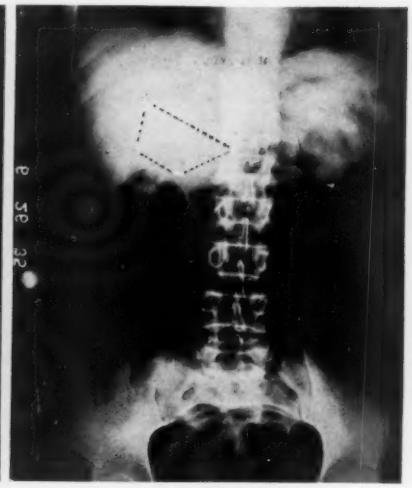

FIG. 2d.—June 26, 1935.

next four months. The total for this period was 5,772 R. units. After a four months' interval treatments were resumed and continued until an additional 4,602 R. units had been given. These ended about 15 months after operation and no further treatment has been administered since.

FIG. 2e.—October 7, 1936.

FIG. 2f.—March 8, 1938.

FIG. 2.—Successive roentgenograms showing the position of the silver clips, indicating steady diminution in the size of the tumor even after roentgenotherapy was stopped.

Follow-Up.—The patient has been carefully observed at regular intervals during the five years that have now elapsed since operation. Coincident with the first few months of roentgen radiation his pain gradually disappeared and he has remained symptom free since.

Far more significant than his subjective improvement have been the disappearance of a palpable tumor and the progressive change in the position of the silver clips marking the outline of the tumor. A comparison of the position of the clips in successive roentgenograms has shown impressive diminution in the size of the tumor and what is more, the decrease has continued even after the roentgenotherapy was ended (Fig. 2). An estimate of the volume of the tumor as it exists to-day, indicates that it is about one-sixth of its original volume. A graphic representation of the change has been plotted in Chart 1.

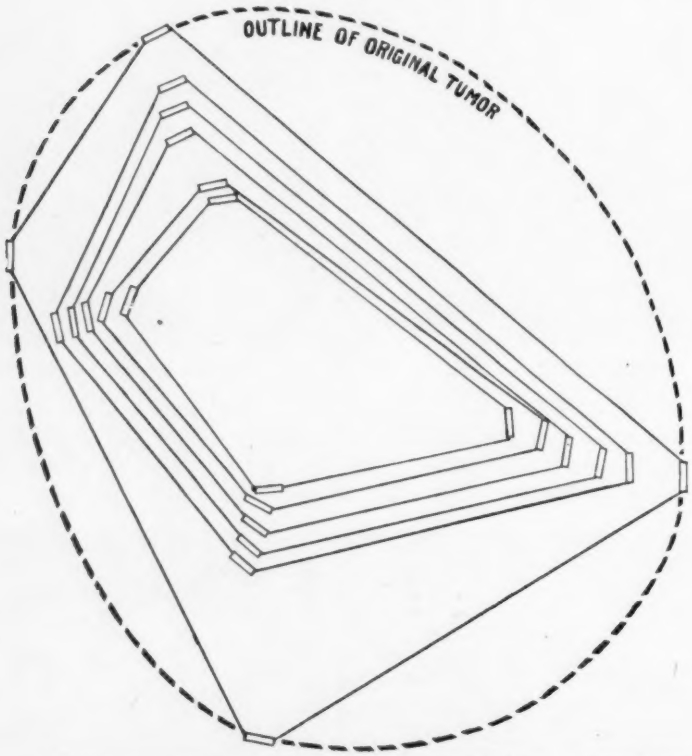

CHART 1.—Graphic representation of the size of the tumor at various intervals over a five-year period. The lines, from without inward, represent the relative sizes on the following dates: March 20, 1933, October 19, 1933, May 3, 1934, June 26, 1935, October 7, 1936, and March 8, 1938.

DISCUSSION.—Although one may perhaps question the cytologic basis for considering cavernous hemagiomata of the liver as true neoplasms, these benign masses often attain large size producing local discomfort from drag on the liver and numerous "neighborhood signs" from pressure on adjacent structures. Most surgeons have had experience in dealing with hemorrhage of friable liver substance in traumatic wounds of the organ. Coagulation by heat, electrocoagulation, gauze packing and numerous mechanical devices designed to prevent the suture material from cutting through the soft liver tissues, all have their place in effecting hemostasis. Nevertheless, the resection of a large segment of the liver may well be considered as an extremely

difficult and dangerous procedure. When it is undertaken as a life saving measure it represents an entirely different problem than when it is elected for the removal of a benign tumor, the existence of which is compatible with life for an indeterminable period. In those infrequent instances when the angioma has developed a pedicle and lies free of the liver, its resection in the hands of a competent surgeon is certainly indicated. However, no surgical procedure of a semi-elective nature is justified if it carries with it undue hazard. This premise would hold true even if alternative therapeutic measures were inadequate.

From the point of view of the pathology of vascular tumors it may be said that in general they begin as benign or as malignant lesions. A few benign angiomata over the body surfaces have developed malignant features but this has never been conclusively shown to have occurred in angiomata of the liver; if possible it must be extremely rare.

Roentgenotherapy has certain limits of usefulness but its effect on the purely endothelial architecture is one of its most successful uses. The method of outlining the borders of intracranial tumors with silver clips was employed to advantage for many years by Dr. Harvey Cushing. It lends itself particularly well to the subsequent study of a mass which is being irradiated. Diminution in the size of the mass thus becomes incontroversial and any subsequent expansion of the lesion can be readily ascertained. It would seem, therefore, that the large cavernous hemangiomata of the liver, which cannot be removed readily by surgery, can be successfully treated and their courses followed by the use of roentgenologic examination.

CONCLUSIONS

(1) Cavernous hemangiomata are benign tumors which occur, not infrequently, in the liver and occasionally attain large size.

(2) When large, these tumors may produce pain in the upper abdomen and numerous complaints from displacement of adjacent structures.

(3) They tend to become pedunculated by virtue of gravity and when thus pedunculated their excision is greatly simplified.

(4) When large and deeply embedded in liver tissue, their removal is hazardous and probably unjustified.

(5) Prolonged roentgenotherapy tends to reduce angiomata. A case is recorded in which the use of this type of therapy has produced a marked and sustained decrease in a large hepatic angioma.

(6) A method of studying recession of such a tumor by placing silver clips about its periphery is emphasized.

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CARCINOMA OF THE PERIPAPILLARY PORTION OF THE DUODENUM

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PART TWO

Age and Sex Incidence.—In this series of 222 cases, there were 139 males (five Negroes), varying in age from 15 to 81, an average age of about 53.4, and 83 females, varying in age from 24 to 82, an average age of 55.3. It was surprising to find a relatively large number of comparatively young individuals in this group. There were six males, age 15, 16, 18, 34, 34 and 34, respectively, and seven women, age 24, 29, 32, 33, 33, 34 and 36, respectively.

It is practically impossible to make an accurate estimate of the true incidence of carcinoma of the peripapillary region of the duodenum from the statistical analyses of the cases that have been reported, predicated upon the requirements for their acceptance, as set forth in the present communication. Owing to the impulse to report new studies of this unusual condition, one finds the literature cluttered up with many case reports that are not genuine examples, and the misinformation thus established is propagated in succeeding reports. Our own cases were selected as carefully as possible, and a number of additional cases, listed under the diagnosis of carcinoma of the duodenum, from the records of the Philadelphia General Hospital were rejected because we were not personally satisfied with the interpretation of the clinical and pathologic findings. Many authors have repeatedly stated that the second portion of the duodenum undergoes malignant transformation far more frequently than the other segments. In general, this is true if it applies to all the epithelial structures comprising the papilla of Vater, that is, the intestinal mucous membrane, terminal common bile and pancreatic ducts and ampulla of Vater. As shown above, however, even after the most painstaking review and study of the anatomic specimen, including microscopic examination, it is frequently impossible to determine the exact source of the neoplasm. Until more and better information is obtainable, it will be impossible to affirm or deny the belief that the intestinal mucosa of the second portion of the duodenum (peripapillary region) is the segment most susceptible to cancer. It is,

likewise, futile to compare the incidence of duodenal carcinoma with that of the rest of the small intestine.

Fourteen cases (13 of our own, and one reported by Boston and Jodzis) were observed at the Philadelphia General Hospital among 22,152 autopsies, from January 1, 1920, to December 31, 1936, and of these, 2,687 showed carcinoma, an incidence of 0.063 per cent of all autopsies, and 0.52 per cent of all carcinomata. Four cases (one of which has been reported elsewhere) from the Jefferson Hospital, from the findings in 4,154 autopsies, among which were 352 carcinomata, give an incidence of 0.096 per cent of all autopsies, and 1.13 per cent of all carcinomata.

Anatomy of Papilla of Vater.—The major duodenal papilla is situated in the medial aspect of the descending portion of the duodenum, 7 to 10 cm. from the pylorus. The undistended papilla is 5 Mm. in length. Above it is often a hood-like fold (*valvula connivens*) and below it a variable fold or frenum which forms a continuation of the plica longitudinalis. Its structure is essentially that of the duodenum with the ampulla of Vater passing through its center. The duodenal surface is covered by mucous membrane containing villi and glands of Lieberkühn and is continuous with that of the intestine. The submucosa consists of firm connective tissue in which Brunner's glands are dispersed with greater frequency than is usually indicated. For the detailed description of the external surface of the papilla with its relation to the surrounding intestinal musculature, together with the relation of the terminal portions of the common and pancreatic ducts, the reader is referred to a recent description by Dardinski.

The results obtained, with regard to the presence of an ampulla and the point of termination of the common and pancreatic ducts, vary. A true ampulla, in the sense of a small pouch or sacculation lying within the papilla, according to Letulle and Nattan-Larrier, is present in only one-third to one-fourth of all individuals. Holzapfel, in a study of 50 cases, found that the common and pancreatic ducts entered separately into the papilla in 30 cases, had a common entrance into the papilla in ten cases, entered separately into two papillae in nine, and in one, the union of the two ducts took place in the papilla itself. Dardinski states that true ampulla dilatation, within the papilla, is present only in those cases in which the two ducts unite 5 Mm., or more, from the outlet. In the remainder, both ducts are separated by a thin membrane formed by the adjacent walls of the pancreatic and common ducts which extends from the base of the papilla to the point where they unite. His results, based on a study of 100 cases, were as follows: 51 cases, both ducts emptied separately into the tip of the papilla. In 12 cases, both ducts united in the papilla 1 Mm. from its outlet, in five cases, 2 Mm. from its outlet, in 12 cases 3 Mm. from its outlet, in 10 cases, 4 Mm. from its outlet, in four cases, 5 Mm. from its outlet and in four cases, 1 cm. from its outlet. In one case, both ducts emptied separately into the intestine, and in another case, the pancreatic duct passed through the major papilla and the common

duct passed through a slit-like opening in the wall of the intestine 1 cm. below the tip of the papilla.

The intraduodenal portion of the common duct is composed of numerous longitudinal folds 2 to 3 Mm. in length and from 2 to 3 Mm. in width. The tip, or end, of one fold fuses with the tip, or side, of another fold forming by this union pockets or cavities around the entire inner surface of the papilla. In the final 1 to 2 Mm. of the papilla there is no fusion of these folds—on the contrary they hang free. The intrapapillary portion of the pancreatic duct contains similar folds, smaller in size but not as prominent, and they do not form pockets as described above. Such a complicated arrangement is not abnormal or the result of inflammatory adhesions but is present throughout life.

(I) Primary Carcinoma of the Ampulla of Vater.—Many cases are described in the literature, purported to be examples of primary carcinoma of the ampulla of Vater, but none of these fulfilled the rigid specifications set up for cancer of this origin. Case 15 presents the clinical record and protocol of an autopsy performed upon a subject who died of obstructive jaundice, incident to a small malignant polyp originating from the mucous membrane of the ampulla of Vater. The growth permeated the surrounding pancreas and muscular wall of the duodenum, but so far as we could determine it did not involve the surface epithelium of the intestinal mucosa or of the common bile or pancreatic ducts. This case is, therefore, presented as an original example of primary carcinoma of the ampulla of Vater.

(II) Primary Carcinoma of the Terminal Duct of Wirsung.—We have classified three cases from the literature in this group but have had no personal experience with this type of lesion. In Letulle and Verliac's case, the papilla of Vater was apparently normal. The pancreatic duct was considerably distended and a probe introduced into it did not pass into the ampulla of Vater, at which point the duct was completely obstructed. The terminal portion of the common bile duct was extremely narrow but still permeable, as a sound could be passed into it; the stenosis was partial and parietal, being situated 3 Mm. above the orifice of the ampulla of Vater at a point corresponding precisely to the obstruction in the duct of Wirsung. The gallbladder and bile ducts were markedly distended and the liver showed the typical effects of biliary stasis. The pancreas was firm, indurated and markedly atrophied. In Carnot and Harvier's case, the papilla of Vater appeared as a voluminous pedunculated mass the size of an ordinary lymph node, with numerous fine villous projections appearing through its orifice. A longitudinal section through the ampulla of Vater showed deviation of the common bile duct which was completely flattened but not entirely obliterated and was not involved by the new growth. The duct of Wirsung was markedly dilated and contained a firm, whitish, neoplastic mass, the size of a pea, taking origin from its inferior wall and extending into the wall of the duodenum to form a small indurated plaque immediately beneath the papilla of Vater. Numerous villous projections on the surface of the duct extended through the orifice of

the papilla into the duodenum. The cystic duct in its terminal portion was compressed by two enlarged lymph nodes. The gallbladder was dilated and pyriform; the extrahepatic and intrahepatic bile ducts were dilated; the liver showing the characteristic changes of biliary stasis and the pancreas appearing normal in consistency. In Hadfield's case, the biliary papilla was enlarged, prominent, and projected for 1 cm. into the lumen of the duodenum. A catheter was easily passed into its orifice for a distance of about 1 cm., where it met with an obstruction. The ampulla of Vater was exposed, and projecting into it was a white, firm spherical new growth, 1.5 cm. in diameter, arising by a broad base of attachment from the posterior wall of the pancreatic duct. The neoplasm half filled the ampulla, which appeared dilated, but its mucous membrane was not infiltrated. The common bile duct was deviated to one side by pressure of the primary neoplasm. The biliary and pancreatic ducts were widely distended. The regional lymph nodes were enlarged, fixed and secondarily involved. The pancreas was moderately firm and atrophic and the liver showed a mild biliary cirrhosis. Microscopically, all three cases were adenocarcinoma with anaplasia a pronounced feature in the last case.

(III) Primary Carcinoma of the Terminal Common Bile Duct.—The cases included under this heading will be considered in a separate communication dealing with primary carcinoma of the extrahepatic bile ducts. A brief summary of the morbid anatomy of this lesion is presented here for the sake of completeness, but these cases are omitted from the analysis in the clinical and statistical sections of this paper. Of 21 cases of primary carcinoma of the common bile duct, seven were located in the terminal segment of the duct. In one case, a small, round, firm, whitish mass, the size of a cherry stone, was implanted on an indurated base, at the point where the common duct entered the wall of the duodenum. In another case, the duct was normal for a distance of 2 cm. from the apex of the papilla of Vater, and then for a distance of 8 to 10 cm. it showed multiple, soft, vegetating tumor nodules, varying from the size of a pea to that of a small hazel-nut, with the mucosa in the intervals thickened, and hyperemic but not ulcerated. In five cases, the neoplasm formed a diffuse, firm, grayish or yellowish, stenosing type of growth usually 1 to 2 cm. in length and 4 to 5 Mm. in thickness. There were metastases in the regional lymph nodes and liver, and extension into the head of the pancreas in one case each.

(IV) Primary Carcinoma of the Intestinal Mucous Membrane Covering the Papilla of Vater.—Many authors have a tendency to derive neoplasms of the peripapillary region of the duodenum from the duodenal mucosa, but few offer any real proof for holding this belief. The intestinal mucous membrane was apparently the source of the neoplasm in three cases. In Borelius' Case 4, the papilla of Vater projected 1 cm. into the lumen of the intestine as a fine reddish-brown navel-like structure 0.5 cm. in diameter, villous on the surface. The mucous membrane of the common bile and pancreatic ducts was smooth and without noticeable change, although the primary neoplasm formed a papillary crown around the orifice of the former

and partially compressed the latter. Metastatic lesions were present in the liver. In Le Noir and Courcoux's case, a small villous tumor of the ampulla (papilla?) formed an oblong projection on the intestinal mucosa resulting in complete obstruction of the common bile and pancreatic ducts which were markedly dilated. Microscopically, the mucosa of both ducts was normal and the authors concluded that the neoplasm originated in the duodenal mucosa. In Countryman's case, the second portion of the duodenum was occupied by a cauliflower-like growth 12 cm. in length with its widest portion at the level of the papilla of Vater, where it encircled half the circumference of the bowel. The margins were raised and wavy and the tissue in the center was friable and grayish-pink. The common bile and pancreatic ducts opened separately through small orifices into the duodenum, 2 cm. below the papilla and, although they were both dilated above, their mucous linings were everywhere smooth. The terminal 1.75 cm. of the common bile duct was surrounded by the neoplasm, and metastatic lesions were present in the peripancreatic, periductal, perirenal and gastric lymph nodes and in the thoracic duct, liver, pancreas and lungs. Microscopically, an abrupt change from the normal duodenal mucosa to neoplasia was observed.

(V) Carcinoma Involving All the Epithelial Structures of the Papilla of Vater Under Groups I, II, III and IV.—A large majority of all cases of carcinoma of the peripapillary region of the duodenum fall into this large indeterminate group. Since, as stated previously, the structures comprising this region are of small size, complex in arrangement, and variable in their anatomic relationships, the primary site of neoplasms arising anywhere in this area is quickly obscured owing to spread to adjacent tissues. This early involvement of adjacent tissues depends chiefly upon the close anatomic relationships of the structures in this region rather than rapid neoplastic proliferation, thus precluding the classification of these growths on any basis other than extent of involvement at the time of observation, as was done in the preceding groups. It is also difficult to make allowances for anatomic anomalies, since with extensive tumor formation and ulceration, variation or even absence of structure cannot be definitely ascribed either to congenital defect or neoplastic compression or destruction. Judging from the statistical data regarding the incidence of occurrence of an ampulla of Vater, it is reasonable to suppose that it was anatomically absent in a certain proportion of these cases. The fact, however, that descriptions of it were frequently lacking in the reports does not materially affect the proposed classification of these tumors. In no case was the intestinal mucous membrane of the duodenum indubitably shown to be free of neoplasm, and in the majority it was definitely proved to be involved.

One hundred and eighty-two cases (168 from the literature and our Cases 1 to 14) were classified under this heading. The duodenal neoplasms in this group varied in size from small, barely perceptible, localized thickenings or plaques of the mucous membrane of the papilla of Vater to a large cancerous mass 12 cm. in length spread throughout the second and into the adjacent first

and third portions of the duodenum. Between these extremes there were many variations.

The tumor was well limited to the papilla of Vater and not ulcerated in 103 cases. More than a third of these were described as vegetating, papillary or cauliflower-like, usually firm and inelastic and less frequently soft and friable. The majority varied in size from that of a pea to a pigeon's egg and three attained the dimensions of a small apple. At least one or more measurements were accurately stated in 22 cases, the average growth being 1.8x1.3x 1.3 cm., and the largest, 3 to 4 cm. in length. In many instances these limited growths formed a cylindrical or conical mass projecting into the lumen of the duodenum, sometimes freely movable or firmly fixed to the duodenal wall by a broad pedicle. In one case, the papilla was described as everted, in a manner not unlike that with stone impaction. The tumor masses were colored varying shades of white, gray and red, and cut section occasionally revealed small, yellowish, necrotic areas.

In 22 additional cases, in which the tumor was not ulcerated, there was extension on to the surface of the duodenum beyond the limits of the papilla. The latter structure under these circumstances was either displaced or its identity occasionally lost. At least one dimension was accurately stated in 16 of these diffuse growths, the average being 4.9x4.2x1.5 cm. The tumors were varying shades of gray, white, yellow and red, hard or soft, nodular or villous-like. Five were stenotic, four annular, and in three cases the lumen of the duodenum was almost entirely filled by a large fungating growth. Occasionally, the greatest dimension of the growth was in the transverse axis of the bowel causing distortion of the plicae, and in one instance resembling an enormous *valvula connivens*. Involvement of the wall of the duodenum was variable in extent. The tumor appeared superficial in some cases, extended deeply even into the head of the pancreas in others, and in one, formed a neoplastic mass on the serosa. Raviart and Lorthois' case exhibited two small tumors, one confined to the papilla of Vater and another 2 cm. below, apparently limited to the intestinal mucous membrane.

The proliferation and local spread of the neoplasm is obviously slow and indolent in many cases and its beginning inconspicuous. From the following, it may be concluded that, although with symptoms severe enough to call for surgical interference, the primary neoplasm may be actually undetectable by direct inspection and palpation. Observations on rapidity of growth were made in six cases. In Abell's Case 2, the papilla of Vater was everted into the lumen of the intestine in a manner not unlike that with stone impaction, and a biopsy was taken. At the second operation, 31 months later, a tumor mass 3.5 cm. in diameter involved the duodenum and pancreas. In Case 3, reported by the same author, the papilla formed a well defined projection 0.6 cm. in diameter, and, 10 weeks later, the growth measured 1.9x1.6x1.2 cm. In Santero's Case 1, the tumor at first measured 2x1.5 cm. and, 17 months later, a recurring mass 5x2.5 cm. was excised. Harbin, Harbin and Harbin stated that the tumor mass in the duodenum in their case was only

slightly larger two and one-half months after their initial observation. In Mateer and Hartman's case, a small mass of tissue was found in the region of the papilla and at autopsy, 22 months later, a papillomatous tumor, 4 cm. in diameter and elevated 2 cm., completely filled the lumen of the duodenum. Pemberton inspected the tumor in his case on three different occasions. Exploration of the duodenum at the first operation revealed nothing abnormal; three months later, a soft nodule 2.5x1.5 cm. was excised and at the third operation, 20 months later, a firm mass 10x12 cm. in diameter involved the second portion of the duodenum.

Ulceration occurred in 57 cases. The ulcer in 31 cases was fairly well limited to the enlarged papilla; in 22 of these it was quite small, superficial, and usually situated at the apex of the papilla, while in the remaining nine cases the ulcer varied in size up to 2 cm. in diameter, as a result of which the papilla was practically destroyed. In 26 cases there was ulceration well beyond the limits of the papilla, varying in size from 2 to 12 cm., the average of 12 stated measurements being about 4 cm. The papilla was completely destroyed in six of these cases, the terminal ends of the common and pancreatic ducts opening separately into the base of the ulcer. In one case the lower end of the common bile duct was laid bare for a distance of 1 cm. In three instances the papilla persisted in the center of an ulcer as a raw fungiform or mushroom-like, pea-sized projection. In a few, only one side or a portion of the papilla was destroyed. Some ulcers were centrally depressed and crater-like, with extension downward into the pancreas in two cases. The base was variously described as gray-yellow, pink, or green, black, shaggy, irregular, granular or worm-eaten, and firm, resistant, indurated or cartilaginous. The margins were usually firm and indurated, undermined in two cases, raised and rolled in eight, while in seven, the edges blended abruptly with the adjacent duodenal mucosa.

A statement regarding examination of the ampulla of Vater was made in 17 cases. This structure appeared to be congenitally absent in four cases, and in several others its presence or absence was difficult to establish owing to extensive ulceration and destruction of the papilla, the bile and pancreatic ducts under these circumstances opening separately into the base of ulcers as noted above. In six cases there was a neoplastic change on the surface of the ampulla varying from slight thickening of the mucous membrane to definite polypoid masses the size of a split-pea or larger, and in two, ulceration was also present. Almost complete obstruction or obliteration of the ampulla occurred in six cases. Occasionally small tumor masses projected through its orifice and were visible in the duodenum.

Biliary obstruction of some degree was present in all but four cases. Obstruction was complete in 44 cases, that is, the common duct was impervious to the passage of a sound, and pressure upon the gallbladder failed to elicit a flow of bile into the duodenum. Partial obstruction was said to exist in 28 cases. In the remainder, no statement was made regarding this feature. Jaundice may come and go in this condition and at least one mechanism involved

in spontaneous relief of obstruction is illustrated by Descos and Bériel's patient, in whom jaundice disappeared as the result of extensive ulceration of the papilla of Vater. Other mechanisms include increasing bile pressure sufficient to overcome the obstacle and absorption of inflammatory exudates and edema which may close the terminal orifice of the common bile duct. The four cases in which there was no biliary stasis or bile duct dilatation are of particular interest and are discussed below.

Common duct obstruction usually developed in the intramural segment due either to neoplastic stricture or to tumor growth within the lumen. Biliary stasis was further accentuated in a few cases by pressure of the primary duodenal tumor, metastatic growths in the pancreas or regional lymph nodes or by biliary calculi. In 43 cases the mucous surface of the terminal end of the common duct showed one or more elevated projections varying from slight granular excrescences to nodules or polypoid masses measuring as much as 2.4x1.5 cm. These were yellow, gray, friable, and occasionally ulcerated, in rare instances extending through the orifice of the duct into the lumen of the intestine. The annular neoplastic stricture, responsible for most cases of obstruction, is exemplified in the cases of Hultgren and Santero. In the former, the common duct, for a distance of 1 cm. from its point of exit into the intestine, was narrowed by an annular, infiltrating tumor mass, hard, sclerotic, grayish-white and 2 Mm. thick. In Santero's case, the terminal end of the duct was represented by a fibrous cord measuring 1x1 cm.

Dilatation of the common bile duct began, as a rule, well down in its terminal portion, 1 cm. or less from the apex of the papilla. In those cases, however, in which obstruction was due to a pancreatic lesion or cancerous lymph nodes, the point of constriction and of dilatation was correspondingly higher. The degree of distention of the common duct varied depending on the degree of obstruction, measuring 5 to 8 cm. in circumference with complete obstruction. The fluid content was dark brown, green, yellow, clear or white and thick, tarry, mucoid or watery. White bile was noted in nine cases, obstruction being apparently complete in all.

Common duct calculi occurred in seven cases, being multiple in five, and varied in size from fine sand or gravel to a spherical stone 5 cm. in diameter. Obstruction was not attributed solely to gallstones in any case. In a few instances the duct showed evidences of previous inflammation and thickening, and in one case (Murgoci) there was a bronchobiliary fistula with stones in the lung. In two cases, although stones were found in the common duct at autopsy, these were not palpated at previous operation and the gallbladder was free of calculi.

Obstruction of the duct of Wirsung was complete in 11 cases, definitely incomplete in 17 and probably incomplete in 37, while in 13 cases it was apparently unaffected. The duct of Santorini was obstructed and dilated in two cases and was said to be normal in three others. The exact mechanism by which obstruction of the duct of Wirsung was effected was not always clearly stated. It was probably most frequently brought about by compression

of the intraduodenal segment of the duct by the primary tumor or by secondary deposits in the pancreas. In two cases, however, obstruction was effected by occlusion of the orifice of the duct of Wirsung by tumor masses on the mucous surface. Proximal to the obstruction, the duct of Wirsung measured as much as 4.7 cm. in circumference in the head of the pancreas. The ductal dilatation extended into the finest ramifications and gave the organ a pitted honeycombed appearance with the formation of multiple cystic cavities 1 to 2 cm. in diameter. In a few cases, the pancreas was converted into a longitudinal cystic mass with the duct measuring as much as 1.8 cm. in circumference in its most distal portion, the residual parenchyma forming a thin mantle 1 to 6 Mm. thick. The ductal contents were pale, watery, clear, mucoid and sometimes black, yellow and green. Concretions were present in the pancreatic duct radicles in a single instance (Cade). In only one instance, apparently, was it possible to state that the common and pancreatic ducts were converted into a common communicating channel (Murgoci). Even in the cases in which the contents of the pancreatic duct were colored, it is doubtful that this was due to reflux of bile.

The pancreas was described in 117 cases, and in 25 of these it appeared normal. The pancreas was firm, indurated and fibrotic in 48 cases, in many atrophic and in a few enlarged. Abscesses were present in five cases and areas of fat necrosis in six, three of which followed celiotomy. Secondary neoplastic invasion of the pancreas occurred in 34 cases. Occasionally an ulcerated primary lesion in the duodenum extended downward into the pancreas and in a few, a well defined tumor mass was noted, but in the majority no further description of these secondary deposits was made. In Cohen and Colp's Case 4, an accessory pancreas, the size of a half dollar, in the anterior wall of the duodenum, showed neoplastic involvement microscopically, although the pancreas proper was normal.

The hepatic changes, where noted, resembled, for the most part, those already described as characteristic of obstructive jaundice (Lieber and Stewart). Since the condition of peripapillary carcinoma of the duodenum lasts for a variable period of time and jaundice appears and disappears alternatingly, the hepatic damage sustained is frequently severe. The liver was, therefore, usually enlarged, although sometimes unchanged or even diminished in size and the surface occasionally finely or coarsely nodular but usually smooth and tense. The cut surface was deeply bile-stained and the intrahepatic ducts were distended frequently with white bile. Biliary cirrhosis was present in 32 cases and in several of these the hepatic damage was severe.

Various operative procedures were performed upon the biliary passages for reestablishment of biliary flow into the gastro-intestinal tract or the external drainage of bile. However, postoperative studies of the liver were not carried out to determine the immediate functional and morphologic effects of biliary decompression upon the hepatic parenchyma. Likewise little or no attention was paid to the more remote effects of cholecysto-enterostomy or cholecystogastrostomy upon the biliary ducts and connective tissue within the

liver. In three of our patients who were subjected to cholecystogastrostomy or cholecystoduodenostomy, the gallbladder was distended with blood clots, which obviously formed a barrier to biliary drainage. One patient died nine days after operation without abatement of the jaundice and at autopsy the liver showed the characteristic changes of total biliary stasis. Similar hepatic changes were noted in the second patient dying one day postoperatively. The third patient died five days after operation, with increase of jaundice clinically, and the liver showed marked degeneration and necrosis similar in extent and distribution to that described by us following decompression in pancreatic carcinoma (Stewart and Lieber). Multiple small abscesses were present in the liver in 11 cases, occasionally distributed along the branches of the portal vein or small intrahepatic biliary ducts which occasionally also showed cholangeitis. In two cases, suppurative lesions of the liver followed eight to ten months respectively after cholecystogastrostomy. Among the more unusual findings were an echinococcus cyst, calculi in the intrahepatic ducts and spontaneous rupture of the liver, one case each. The ruptured liver occurred in the presence of extensive metastases to this organ, which weighed 3,970 Gm., and death was attributed to a massive intraperitoneal hemorrhage of 2,500 cc. In Murgoci's case there were pericholecystic, subphrenic and hepatic abscesses and a bronchobiliary fistula which extended through the diaphragm into a cavity in the lower lobe of the right lung which contained inspissated bile and gallstones; this cavity in turn communicated with a bronchus. In Ely's case, the left kidney was enclosed in an irregular cavity traced to the edge of the left lobe of the liver where it was found continuous with the ruptured extremity of a dilated bile duct. There was no peritonitis in Ely's case, as the fistulous sac lay entirely behind the peritoneum.

The gallbladder was variably distended in 131 cases, contracted or not distended in 12 and no mention of this feature was made in six, while in 33 there was no note regarding this viscus. The distention varied from slight to enormous. In the majority of cases the gallbladder was greatly distended measuring from 12 to 17 cm. in length and 6 to 10 cm. in width. Upwards of 1,500 cc. of fluid were obtained by incising the gallbladder. The fluid was described as clear, mucoid, colorless or white in 20 cases, pale green or thick and tarry in 13, and purulent in five. In a few others the bile was said to contain grumous mud-like material. In several cases the gallbladder was distended with blood following operation and in at least one case this phenomenon developed spontaneously.

Gallstones were present in the gallbladder in 25 cases, in three of which they were also present in the bile ducts. In four other cases in which stones were found in the common bile duct, none was found in the gallbladder. In Whipple, Parsons and Mullins' Case 2, the gallbladder, at autopsy, was dilated and contained numerous soft stones although it had been free of stones nine months previously when a cholecystogastrostomy was performed. Perforation of the gallbladder occurred in three cases, one of which showed suppurative cholecystitis and another an impacted stone in the cystic duct. A spon-

taneous cholecystocolic fistula was found in Fischel's case. Inflammatory stricture of the cystic duct was noted in a few instances. Pericholecystic adhesions were present in 18 cases.

Among 22,152 autopsies, performed at the Philadelphia General Hospital, gallstones were found in 1,956, or 8.83 per cent. In the present series of 182 cases, stones were present in 29, or 15.9 per cent. This high figure may be of some significance, implying that stones are a predisposing factor in the etiology of cancer in these patients. Of the 1,956 cases of gallstones at the Philadelphia General Hospital, 79 had stones in the common bile duct, an incidence of 4.04 per cent, as contrasted with seven of the 29 present cases, or 24.1 per cent with common duct stones. This high incidence of common duct stones is partly due to the greater facility with which stones may migrate from the gallbladder into distended bile ducts in the presence of biliary obstruction.

Peritoneal effusions were noted in 41 cases, and varied from a slight excess up to eight liters of fluid in one instance. The fluid contained bile in 22 cases, blood in nine, five of which occurred postoperatively, and pus in five. Peritonitis was present in 13 cases, in five of which the inflammatory change was localized to the region of the gallbladder while another was associated with a spontaneous bronchobiliary fistula. Inflammatory peritoneal adhesions were present in 39 cases, occurring postoperatively in five. In order of frequency the organs involved by adhesions were gallbladder, intestines, liver, pancreas and stomach. At times the biliary passages were completely buried in dense adhesions and were almost impossible to identify at operation.

Extension and metastases of the primary neoplasm occurred in at least 79 cases (43.6 per cent). This is a highly conservative figure, when it is considered that in 51 cases examination was limited to biopsy material and surgical specimens only, and a few autopsies were incomplete. A definitely negative statement regarding neoplastic spread was made in only 31 cases, while in 41 additional cases no comment was made. Direct extension into the head of the pancreas occurred in 34 cases and was questionably present in two others. There were metastases to the regional lymph nodes in 36 cases —liver, 31; lungs, two; perirenal lymph nodes, two; and the following one each, left kidney, gallbladder, thoracic duct and left supraclavicular, peribronchial and gastric lymph nodes. Implantation metastases were observed in the peritoneum in two cases. The most extensive secondary deposits were present in Butz's case, being observed in the right lung, left pleura, liver, pancreas and left supraclavicular, bronchial and retroperitoneal lymph nodes.

Histology.—All but four of the 182 cases in this series were glandular carcinomata. The exceptions were three adenosquamous (Mateer and Hartman, Case 5; Hoffman and Pack, Case 8, and Lieber, Stewart and Morgan), and one squamous cell carcinoma (Cohen and Colp, Case 5). In approximately half the cases no other histologic details were given aside from the designation of glandular carcinoma. Acinar structures were present in the majority of the remainder and were usually fairly regular, although in a

few they were branching, elongated or otherwise imperfect, and in six instances markedly dilated to form microcysts. The acini were lined by single and in a few instances by multiple layers of cylindrical, columnar or cuboidal cells which, in 31 cases, formed papillary infoldings or projections. The atypical cells grew solidly in clumps, strands, cords or nests in 39 cases, and in five of these acini were definitely absent. Some degree of irregularity in size, shape and staining of the cells occurred in 37 cases, and in a few the cells were described as embryonic or anaplastic. Mitotic figures were observed in 25 cases but were numerous in only a few. Considerable quantities of mucinous material occurred in and between the cells and acini in seven cases, two of which were designated as mucoid or colloid carcinoma and another as medullary carcinoma. The lumens of the acini occasionally contained desquamated cells, débris, small amounts of mucin and leukocytes. The connective tissue stroma, varying in cellularity and usually infiltrated with inflammatory cells, was abundant in 24 cases and scanty in 12. Areas of necrosis were noted in eight cases, miliary abscesses in one, and perivascular and perineural infiltration of tumor cells in another.

Several authors expressed an opinion regarding the origin of the neoplasm in their case, these views being advanced much more frequently in the earlier reports than in the more recent ones. Thus the tumor was stated as having been derived from the duodenal mucous membrane in 31 cases, from the common bile duct in four, from the common bile duct, pancreatic duct or duodenum in two, and from the following in one each—common bile or pancreatic ducts, ampulla of Vater, common duct or ampulla of Vater and Brunner's glands. The reasons given for deriving the tumor from one or another of the structures just listed were wholly inadequate and in our opinion do not influence its classification in the group of carcinomata involving all the epithelial structures comprising the papilla of Vater as in Groups I, II, III and IV, described above.

VI Carcinoma Involving the Epithelial Structures Comprising the Papilla of Vater Exclusive of the Intestinal Mucous Membrane.—Thirty-one cases from the literature were included in this group as examples of neoplastic involvement of the combined terminal common bile duct and duct of Wirsung together with the ampulla of Vater, if present. Our Cases 16 and 17 are examples of this type of lesion. The duodenal mucous membrane covering the papilla of Vater was free of tumor in all instances and can, therefore, be dismissed as a source of origin for these growths. Otherwise, however, the primary source remains obscure.

The duodenum, opened at celiotomy or at autopsy, showed an unusually prominent papilla of Vater which projected forward as a cylindroconical body into the lumen of the bowel. It varied in size from that of a cherry to a plum, the largest stated diameter being 3 cm. The papilla was usually firm and resistant and the mucous membrane covering it was smooth, not thickened and usually freely movable. The orifice was patent in all instances and appeared dilated and stretched in a few. Just beyond the orifice, however, a

sound usually met with resistance, obstruction being complete in nine cases and incomplete in 24. It was demonstrated in one case that obstruction was due to pressure and kinking rather than to invasion and obliteration of the lumen by neoplasm. In eight instances, the tumor was believed to emanate from the wall of the ampulla of Vater but in each of these the common bile duct or duct of Wirsung, or both, showed associated neoplastic changes on the surface.

The common bile duct in its lower few to 30 Mm. was regularly thickened. This thickening was usually attributed in the reports to an annular, grayish-white, indurated, firm or occasionally friable growth often barely perceptible but at other times measuring 2 cm. in diameter. Elevated tumor excrescences studded the mucous surface in 15 cases, five of which were distinctly papillary, villous or mulberry-like while seven were localized and pea-sized. Ulceration occurred in four cases. Proximal to the obstruction, the biliary ducts were maximally distended up to a circumference of 10 cm., the ductal contents being colorless in two instances. Gallstones were present in the gallbladder in two cases and in the cystic and common bile ducts in one case each.

The duct of Wirsung was obstructed in 15 cases, not obstructed in three, and no mention of this feature was made in the remainder. The pancreas was reported as normal or unaffected in eight cases. The exact site of obstruction of the duct was localized in only five cases, occurring definitely at the ampulla in three, while in the others the tumor had propagated backwards 2 cm. along the lumen. In three cases the orifice was completely effaced. Proximal to the obstruction, the intrapancreatic ducts were maximally dilated and occasionally contained blood or blood-stained fluid. The parenchymatous tissue usually showed chronic inflammatory changes and atrophy and fat necroses were present in two cases.

Some degree of biliary stasis existed in all the cases in this group. In three cases the hepatic changes showed well advanced biliary cirrhosis, the liver being small and contracted, with a granular surface. Suppurative cholangeitis and hepatic abscesses were present in two cases. Distention of the gallbladder was regularly observed and sometimes the viscus measured 30 cm. in length. Suppurative cholecystitis was associated with cholecystoenterostomy in one case, gallstones in another, and ulceration in two cases, one of which perforated. Stones were present in the gallbladder in two cases. Dilatation of the stomach and proximal duodenum was rarely encountered. Adhesions between the gallbladder and neighboring structures were present in four cases, in one to the spleen. Diffuse fibrinous peritonitis occurred in three cases, hemorrhagic peritoneal effusion in four, and biliary effusion in three, one of which followed perforation of the gallbladder.

Extension and metastases of the primary neoplasm occurred in nine cases, to the regional lymph nodes (five), pancreas (six), liver (four) and lung (one).

Histology.—All the cases in this series were glandular carcinomata. Acini were described in 27 cases, and there was little or no tendency for the tumor

cells to form strands, clumps, nests or cords. The atypical tumor cells were essentially cylindrical, columnar or cuboidal in type, and in ten cases, variation in size, shape and staining of slight degree occurred, but anaplastic features were not marked in any instance. Mitotic figures were numerous in only one case. The stroma varied from scanty to abundant, and areas of necrosis were occasionally observed. The tumor cells permeated the surrounding duodenal musculature and nerve fibers invading the submucosa of the intestine in four instances.

Clinical Features.—Early recognition of carcinoma of the peripapillary portion of the duodenum depends upon a careful, critical evaluation of the symptoms. For this reason, the clinical features are analyzed at some length.

Onset.—Of the 222 cases in this series, the onset was acute in 178, gradual in 29, and at first gradual and then acute in 15.

Symptoms occurring with the acute onset were: Jaundice (126), pain (71), loss of weight (40), loss of strength (36), anorexia (31), vomiting (21), fever (14), nausea (13), constipation (13), diarrhea (10), chills (8), a sense of pressure or weight in the abdomen (8), and infrequently, dyspepsia, epigastric distress, sour eructations, flatulency and abdominal distention. Symptoms occurring after the onset were: Jaundice (47), pain (27), vomiting (24), anorexia (18), abdominal distention (16), diarrhea (14), and infrequently, nausea, constipation, a sense of weight or pressure in the abdomen, flatulency, sour eructations and dyspepsia.

Symptoms occurring with the gradual onset were: Pain (12), anorexia (10), loss of weight and strength (11), a sense of weight or pressure in the abdomen (8), jaundice (6), vomiting (5), diarrhea (4), and less frequently, fever, abdominal distention, flatulency, dyspepsia, constipation and sour eructations. Later manifestations were: Jaundice (24), pain (12), fever (8), loss of weight and strength (7), vomiting (5), and less frequently, abdominal distention, flatulency, a sense of weight or pressure in the abdomen, anorexia, constipation and diarrhea.

In the group of cases with a gradual onset, followed later by an acute phase, the symptoms with the gradual onset were loss of weight and strength (7), pain (5), jaundice (3), a sense of weight or pressure in the abdomen (3), vomiting (2), and constipation, abdominal distention, dyspepsia, nausea and malaise (one each). Symptoms with the acute phase were: Jaundice (10), vomiting (4), pain (3), and chills and fever (2). Later manifestations were: Chills and fever (5), jaundice (2), pain (2), and vomiting, diarrhea and hiccoughs (one each).

Jaundice.—Jaundice was a symptom in all but four of the 222 cases. It occurred with the onset of the condition in 136 cases and later in 82. In the latter cases, the time interval, from the onset to the appearance of jaundice, varied from a few days to four years, averaging three to five months. The antedating symptoms were malaise, feebleness, vomiting, chills and fever, dyspepsia, abdominal soreness, pain, diarrhea and constipation. Infrequently, cutaneous icterus was preceded by pruritis, dark urine or colorless stools. A

few patients gave an antecedent history, the symptoms of which merged with those of the condition under discussion. In Cabot's case, for example, the patient complained of pain in the epigastrium, jaundice, vomiting and chills beginning four years before, the last attack occurring two months before admission to the hospital. In our Case 2, painful attacks of jaundice occurred respectively five years and two years before her last admission with the same symptoms, and each of these was relieved by operation. In our Case 6, there was a history of painless jaundice for a week or ten days on two occasions, one and three years previously.

There was a single attack of jaundice in 186 cases, the icteric tint of the skin never completely disappearing except following surgical intervention. It was marked and fairly constant in 38 cases, in most of which it was of relatively brief duration (one to two months), although one patient showed constant deep jaundice for 12 months without apparent abatement. In 22 cases, the jaundice, although continuous, varied in intensity and occurred at all phases of the condition, early and late. In some cases, sustained jaundice could be accounted for in part by the presence of biliary tract infection and, in at least five cases with jaundice of long duration, stones in the common duct or gallbladder may have been responsible for the variation in the intensity of this symptom. The duration of the jaundice in the cases with a single attack, where the time was accurately stated, varied from a few days to 21 months, being less than one month in 16 cases, one month in 33, two months in 36, three months in 25, four to six months in 42, seven to 12 months in 21, and four, 13, 16, 18 and 21 months, respectively, in one case each.

Multiple attacks of jaundice occurred prior to surgical treatment in 32 cases with two attacks in 17 cases, three attacks in five, four attacks in two, and in eight cases the number of attacks were not stated, although there were at least two. The duration of the individual attacks varied from a few days to nine months, being less than a month in six cases, one month in 10, two months in 5, three months in 4, six months in 2, and seven, eight, nine and 12 months respectively in one case each. The intervals between attacks of jaundice varied from one week to 18 months, being less than a month in 2 cases, one month in 10, two months in 7, six months in 3 and seven, eight, 12 and 18 months respectively in one case each. The total duration, that is, the sum of all the individual attacks and the intervals between them, was as follows: Thirteen were fairly evenly distributed over the first nine months; six occurred between the first and second years; and one each occurred at 27 and 48 months, respectively.

Jaundice occurred as the only symptom in 14 cases, and in 22 others, it occurred in association solely with diarrhea, constipation, loss of weight, loss of strength or chills and fever. Pain was associated with jaundice at the onset of the condition in 54 cases, preceded the appearance of jaundice in 48 and occurred later in 30 cases. Fever, frequently accompanied by chills, occurred in 74 cases, with the onset of jaundice in 16, and after the appearance of jaundice in 56, while in two cases, the exact time of occurrence was not

stated. The fever was sometimes described as irregular, intermittent, septic or low grade. The temperature varied from 100° F. to 102° F., occasionally rising to higher levels terminally.

Jaundice first appeared as a symptom after admission to the hospital in eight cases. In Pozzi's Case 2, for example, the patient developed pain and jaundice while convalescing from bronchopneumonia. Pemberton's patient complained of attacks of pain for two years with loss of 30 pounds in weight, unexplained even after exploratory celiotomy. Two months later, pruritis, followed gradually by jaundice, appeared and a second celiotomy a month later revealed complete obstruction of the common bile duct due to a carcinoma of the papilla of Vater.

Jaundice was never a symptom in four cases which are cited rather fully. Mauclaire and Durrieux's patient complained of violent colicky pains in the epigastrium and hypogastrium, infrequent vomiting and obstipation for 12 days. At autopsy there was an ulcerated, markedly stenotic cancer occupying three-quarters of the circumference of the duodenum, extremely firm and measuring 7 to 8 Mm. in length and 1 cm. in width. The papilla of Vater, although not definitely identified, appeared to correspond to the seat of the cancer but the bile ducts were not obstructed. Lannois and Courmont's patient complained of difficulty in swallowing solid foods, diarrhea and loss of appetite, weight and strength for four and one-half months. One month before admission to the hospital he could no longer swallow food without promptly vomiting. At no time was there a complaint of pain or icterus but obstinate constipation developed terminally. At autopsy, a firm tumor 4x2 cm. completely obstructed the inferior portion of the esophagus, histologically a squamous cell carcinoma; at the level of the papilla of Vater was found a second, reddish-white, mushroom-like, soft tumor, the size of a five franc piece. The papilla of Vater was eccentrically placed to the right and in front of the tumor. A probe easily passed into the common bile duct without meeting an obstruction. Histologically, the duodenal tumor was a cylindrical cell adenocarcinoma.

Del Valle and Brachetto-Brian's patient complained of pain two to three hours after meals and occasionally during the night. The pain radiated to the "pancreaticoduodenal area of Chauffard" and occasionally to the right shoulder blade. The first attack appeared one year before admission to the hospital. The attacks recurred more frequently and with greater intensity. A clinical diagnosis of pyloric ulcer and cholecystitis was made. At celiotomy, the antrum of the stomach and pylorus revealed no ulcer or neoplasm. The gallbladder and bile ducts were enormously distended and an indurated area was palpated in the second portion of the duodenum, which was opened. An oval shaped, firm tumor 3x1x0.3 cm. with firm borders and without ulceration was found, the major papilla forming the superior extremity of the tumor. In Hoffman and Pack's Case 3, the complaints were pain in the abdomen, anorexia, loss of weight and strength, constipation and marked distention after eating, but jaundice was not mentioned. Autopsy revealed an annular,

polypoid carcinoma surrounding the papilla of Vater and extending for 6 cm. along the lumen of the duodenum which was partly obstructed. There was no record of examination of the biliary passages in this case.

The duodenal contents were examined 44 times in 15 patients. Bile was recovered in nine patients examined, and was always absent in six patients, indicating the complete nature of the obstruction. In three patients, bile was detected on the first examination but disappeared subsequently. Interesting information may be obtained by citing some of the cases in which the duodenal contents were repeatedly examined. In Carnot and Libert's patient, the icterus began to recede several days after admission to the hospital and finally disappeared, the duodenal contents at this time showing the presence of bile and pancreatic ferments. Two weeks later, there was an absence of bile but pancreatic ferments and blood were present; the examination was repeated again several weeks later with the same results. In Bérard, Mallet-Guy and Croizat's case, bile was detected in the duodenal contents, and, although at operation the degree of biliary obstruction was minimal, evidences of biliary infection existed which probably accounted for the clinical jaundice. In Crohn's Case 3, the onset was with jaundice which cleared during hospitalization, at which time duodenal intubation yielded an abundance of thick, mucoid bile and active pancreatic ferments. On the second admission to the hospital, jaundice was marked and the duodenal contents showed complete absence of bile and a diminution in pancreatic ferments. At autopsy, there was apparently complete obstruction of the pancreatic duct. It is obvious that in certain cases jaundice may be marked clinically and yet bile is detected in the duodenal contents, the icterus being accentuated probably by biliary tract infection or stone. Einhorn and Stetten's case illustrates the fact that although marked biliary obstruction with considerable dilatation of the ducts obtain, yet jaundice may not be recognized clinically. During the entire course of illness in their patient, there was nearly total absence of jaundice except for a transient, slight attack at the inception which subsided after cholecystectomy, despite persistency of the lesion at the papilla of Vater. This the authors accounted for on the basis that the tumor was ulcerative in type and not actually obstructive in character. During a period of two weeks in the latter part of the patient's illness, daily biliary drainage yielded a free flow of bile. A few days after the last drainage, celiotomy revealed a markedly distended common bile duct through which a probe was passed with considerable difficulty.

Pain.—This symptom was present in 132 cases in this series and was absent in 59, no mention of it being made in the remainder. At least nine of the patients, not complaining of definite abdominal pain, did have vague dyspepsia, distress or discomfort, sometimes after meals. In several other patients, vague symptoms of this type preceded the actual onset of pain.

Epigastric pain was manifested in 55 cases, and in 19 of these there was associated pain in the right upper abdominal quadrant. Radiation occurred to one or both shoulders in nine cases, lumbar region nine, and hypogastrium

three. In one case, pain began in the epigastrium and radiated to the right hypochondrium, right iliac fossa and backward to the right shoulder, accompanied by a sense of constriction.

In 36 cases, pain began in the right hypochondrium and radiated to the back in seven, right shoulder in three and right upper arm and right chest in one each. While pain usually began in the two situations mentioned above, in a few cases it began elsewhere, namely, the lumbar region in six cases, the entire abdomen in four, the lower abdomen in two, and substernal region in one. In three of these cases, the pain radiated either to the abdomen, chest, gallbladder region or left arm.

There were few other details regarding pain but it appeared to be intermittent in 50 cases and continuous in 10. The intensity was severe in 40 cases and slight in 10. It was accentuated by food and occurred from one-half to several hours after eating in 20 cases, but in three, there was no relation to food. Di Giovine described the pain in his patient as tolerable, paroxysmal, variable in duration and was referred, at times, to the right shoulder and at other times to the right hypochondrium. Abdominal tenderness was associated with pain in 61 cases, occurred independently of pain in 29, and in association with pain and rigidity in 10. Rigidity alone occurred in two cases and in association with pain in three. Pain was relieved by vomiting in five cases. Nineteen patients complained of a sensation of weight or pressure in the abdomen and in several of these there was no pain. In a few cases, pain was a transient symptom at the onset and in one case, it disappeared with the advent of jaundice. Practically none of the authors emphasized the nocturnal occurrence of pain.

Vomiting.—This occurred with the onset of the condition in 28 cases, later in 34, and was absent in 46. It was intermittent in 23 cases and in a few instances, it became incessant terminally. In seven cases, it occurred after meals. Vomiting was associated with nausea in nine cases, and nausea occurred independently of vomiting in 17. Blood and bile were present in the vomitus in five cases each. Vomiting was associated with jaundice in 20 cases and with pain in 23, the three symptoms occurring simultaneously in eight cases. Vomiting preceded the appearance of jaundice in 20 cases and of pain in eight. It followed the appearance of jaundice in 21 cases and of pain in 20.

Examination of the vomitus, or material obtained for gastric analysis, was made in 27 cases. Free hydrochloric acid was absent in five cases, and in the remainder it varied from 17 to 58, while the total acidity varied from 9 to 90. Blood was present in four specimens and bile in five.

Diarrhea and Constipation.—Diarrhea occurred early in 20 cases and late in 19, while constipation occurred early in 23 and late in 19. The two occurred early in association in four cases, and late in two cases, while diarrhea was preceded by constipation in three cases and followed by constipation in one. One case of diarrhea lasted for eight months. Of the 39 cases with diarrhea, nine showed evidences of obstruction of the pancreatic duct at autopsy.

The stools were pale, gray, clay-colored, white or colorless in 129 cases, and were brown in four cases, in all of which jaundice was clinically present for a week or longer. Blood was present in the stools in 42 cases, and in a few of these the stools were black, massive hemorrhage occurring as a terminal feature in one case. Most of the reports on the occurrence of melena have been published since 1912. Neutral fats were variably increased in 15 cases and fatty acids in 8. The stools were described as fetid in 10 cases.

Physical Examination.—A mass was palpable in the abdomen in 14 cases, but only in four of these could it possibly be ascribed to the primary neoplasm. In Le Blanc's case, a small mass was palpable to the left of the umbilicus and was thought to be an enlarged lymph node. At autopsy there was no enlargement or metastases in the lymph nodes but a mass was found involving the terminal common bile duct, the papilla of Vater and the head of the pancreas. In Doberauer's case, a hazel-nut-sized mass could be rolled under the examining finger, and was situated deep in the region of the duodenum. Celiotomy revealed a hazel-nut-sized tumor of the common bile duct near the duodenum. In Mateer and Hartman's Case 2, a very hard, nodular, circumscribed, slightly movable, nontender mass, the size of a lemon, was palpable to the right of the midline, in the lower epigastrium. It was not connected with the liver and did not move with respiration. At autopsy, a large papillomatous tumor 4 cm. in diameter and elevated 2 cm. above the adjacent duodenal mucosa, surrounded the papilla of Vater and completely filled the lumen of the duodenum. There were metastases to the regional, mesenteric and retroperitoneal nodes. In Hoffman and Pack's Case 11, a hard mass, slightly movable, especially with respiration, and 5 cm. in diameter, was palpable in the epigastrium slightly to the right of the midline. Celiotomy revealed a neoplasm 8 cm. in diameter surrounding the papilla of Vater.

In seven cases a mass was palpated in the right epigastrium or hypochondrium and was probably due, as disclosed at autopsy, to secondary neoplastic deposits in the regional and pancreatic lymph nodes in four, in one of which there was also a large infiltrating mass in the head of the pancreas, and to metastatic nodules in the liver in two cases. The right kidney in Mauclaire and Durrieux's case was palpable as a firm irregular mass. In Hunt and Budd's patient, a large cystic mass occupying the entire left upper quadrant of the abdomen was interpreted as due to a hydronephrotic left kidney; which autopsy confirmed. In Hoffman and Pack's Case 3, a movable, irregular mass the size of an orange was palpable in the region of the right kidney; examination of the kidneys was not mentioned in the autopsy report. A hard mass was palpable in the epigastrium to the right of the vertebral column in Rutishauser's Case 6; this case was complicated by a diaphragmatic hernia, a lumpy mass in the omentum and metastatic lesions in the regional lymph nodes in addition to the primary neoplastic ulcer measuring 5.5 cm. to 6 cm.

The liver was palpably enlarged in 173 cases; sometimes it extended to the umbilicus and in several it was definitely nodular. The gallbladder was palpably distended in 110 cases, and in one instance it reached the level of the

anterosuperior iliac spine. Tenderness was present in 90 cases, with associated abdominal rigidity in 12. Abdominal distention was noted in 26 cases, usually late in the condition, and signs of ascites were elicited in 24 cases. Dilatation of the stomach was found in two cases, in one of which the lower border of the viscus was situated two fingers' breadth above the symphysis pubis. Several enlarged lymph nodes were palpable above the left clavicle in one case, and in the right supraclavicular group in another.

Laboratory Data.—Blood examinations were carried out in 72 cases. A varying grade of anemia was present in 48 instances, the red cell count varying from two to below four million per cm. Hemoglobin estimations varied from 51 to 88 per cent in 19 cases, and in four others the hemoglobin was 25, 28, 32 and 39 per cent, respectively. In the majority of instances the color index was correspondingly low but in 12 cases it varied from 0.9 to 1.3. Although a slight leukocytosis was the rule, the white blood cell count was within normal limits in a few cases and in one there was a slight leukopenia. With jaundice present, the danger from hemorrhage increases and the determination of the circulating bilirubin and estimation of the bleeding and coagulation time should be carried out routinely throughout the course of illness of these patients. The bleeding and coagulation times were estimated in only a few instances, being slightly prolonged in one case and markedly prolonged, to four hours, in another. The Wassermann reaction on the blood serum was positive in six cases. The van den Bergh reaction on the blood serum was described as directly positive in 21 cases, direct and indirect positive in three and delayed and biphasic in one. Quantitative van den Bergh estimations varied from 6.8 to 70 mg. per 100 cc. of blood in 18 cases, with an average of about 20 mg. The icterus index varied from 12 to 280 in 17 determinations, with about 120 as an average. Tests of liver function with bromsulphthalein (2 mg. dosage) in the presence of jaundice showed varying impairment, from slight to 100 per cent retention in 30 minutes in the seven cases examined.

The blood sugar determinations were within normal limits except in five cases showing 134, 150, 160, 250 and 318 mg. per cent respectively. It is interesting that in each of these cases the pancreas was markedly affected. In Meyer and Rosenberg's Case 1, the pancreatic duct was distended with almost clear fluid, probably the result of extension of the primary tumor into the head of the pancreas, and cut section of the organ showed that hardly any pancreatic tissue remained. In Mateer and Hartman's case, there was a chronic pancreatitis and no other mention was made of this organ. The reader is referred to the protocols of our Cases 3, 7 and 13 for the detailed pancreatic changes. In each of these, the pancreatic duct was obstructed and the parenchyma markedly atrophied with extensive fibrosis and chronic inflammatory changes. Blood amylase estimations were carried out in Whipple, Parsons and Mullin's Cases 2 and 3. In the former, the blood amylase was 5.8 prior to the first operation and 11.4 after the third operation eight months later. In the latter, the blood amylase was 40, 13 days after the first opera-

tion, 44, the day after the second operation, remaining below 20 on the succeeding days and rising to 72, 46 days later.

Retention of nitrogenous products in the blood occurred in ten cases, the urea varying from 16 to 220 mg. per cent and the creatinine being correspondingly high, reaching in one instance to 17.2 mg. per cent. Of two of our cases with high nonprotein-nitrogen readings, one showed uremic manifestations clinically, and deep renal pigmentation at autopsy, and the other showed renal arteriosclerosis and marked nephrosis. Blood cholesterol studies were carried out in four cases, values of 225 and 1500 mg. per cent being obtained, the blood cholesterol remaining consistently above 1,000 in one case. Studies of the fibrinogen of the blood were reported in one case in which it varied from 0.64 to 0.9 in five examinations.

Uranalyses.—There was no case in this series in which bile was reported absent from the urine. In a few cases there was no mention of this feature and in the four patients who did not exhibit jaundice clinically, the test for biliary pigments in the urine was apparently not performed. A trace of albumin was detected in 47 cases and in another, large amounts were present. Urobilin was present in 11 cases. The urine was free of sugar in all but two cases examined. A few patients showed the presence of albumin, casts, red blood cells and leukocytes in the urine, which seemed to indicate the presence of nephritis.

Duodenal Analyses.—The duodenal contents were examined 44 times in 15 cases, and bile was detected in nine patients and was always absent in six others. Pancreatic ferments were detected in six cases and were absent in three. In three of the patients, the pancreatic ferments were present in small amounts and in one of these they had disappeared at a second examination. Blood was present in three specimens and many pus cells in two. The diminution or total absence of pancreatic ferments in the duodenal contents could be accounted for by partial or complete obstruction of the duct of Wirsung as proved at autopsy.

Roentgenologic Studies.—The inexactness of roentgenologic diagnosis of carcinoma of the duodenum has been the subject of considerable discussion for many years. We have emphasized, elsewhere (Stewart and Lieber), that with vague and inconstant symptoms occurring early in the course of the disease, the roentgenologic examinations are of value chiefly in ruling out primary tumors in other locations such as the stomach, colon and gallbladder. Roentgenologic studies were carried out in 60 cases, in 11 of which only a "scout" roentgenogram of the abdomen was taken. The presence of a lesion in the region of the papilla of Vater was recognized roentgenographically in 16 cases. A brief analysis of each of these cases is presented comparing the roentgenographic findings with the gross anatomic specimen as disclosed at operation or autopsy.

Propping's patient showed a continual duodenal deformity, and at celiotomy a prominent cherry-sized tumor was found localized to the papilla of Vater. In Abell's Case 2, a tumor of the papilla of Vater was proved by

operation and a cholecystoduodenostomy performed; two and two-thirds years later, roentgenologic examination showed marked deformity and obstruction in the second portion of the duodenum. Celiotomy at this time revealed a rounded, firm, fixed mass, 7.7 cm. in diameter, involving the duodenum and pancreas. In Meyer and Rosenberg's Case 1, a defective duodenal bulb was noted, and autopsy showed an irregular, annular ulcerated tumor at the site of the papilla with extension into the underlying pancreas. In Mateer and Hartman's Case 2, the persistent filling defect observed in the second portion of the duodenum was due to the presence of a peripapillary nodule 4x2 cm. In Lauwer's Case 1, the superior segment of the second portion of the duodenum showed peristaltic movements in the vertical position but in the ventral position, interruption of the duodenal shadow was noted; at celiotomy, the papilla of Vater was occupied by a tumor the size of a strawberry. Swenson and Levin's patient showed, at the first examination, very obvious alterations of duodenal mucosal patterns. A second examination about a year later showed a filling defect in the second portion of the duodenum; autopsy revealed a mushroom-like growth measuring 6.5x7 cm. with the papilla of Vater almost in its center, and the surrounding plicae were distorted.

In the case reported by Harbin, Harbin and Harbin, fluoroscopic examination revealed a moderately dilated but otherwise negative stomach; a constant filling defect occurred in the distal part of the first portion of the duodenum, the proximal segment was dilated and showed rather pronounced peristalsis. Only a small amount of barium passed by the obstruction, two-thirds of the meal remaining in the stomach at the end of 24 hours. At autopsy, three months later, an annular, stenosing, papillomatous tumor attached to the first segment of the second portion of the duodenum almost completely occluded the lumen of the gut. In Doub and Jones' case the stomach was negative; the lumen of the second portion of the duodenum was irregular and displaced somewhat laterally and there was a pressure defect in the cap. The duodenum emptied slowly and no peristaltic waves were seen. There was 15 per cent retention in the stomach at the end of six hours. Autopsy revealed a carcinoma of the papilla of Vater but the exact size of the lesion was not stated. Bérard, Mallet-Guy and Croizat's case is especially interesting. These authors stated that injected lipiodol did not pass into the duodenum; the common bile duct appeared constricted and the rough outline of the sphincter could be made out. Stereoscopic examinations made 15 and 25 minutes later confirmed the radioscopic findings and showed that the common bile duct, 2 cm. in diameter, ended in a sort of point having the appearance of a notch of its external wall. This notch was noted exactly at the site of the ampulla of Vater, and their description was well borne out in the illustrations accompanying their article. At celiotomy a well limited cherry-sized tumor of the ampulla of Vater was found corresponding precisely to the image seen in the lipiodol radiograph.

In Hoffman and Pack's Case 3, there was a filling defect in the prepyloric segment of the stomach and evidence of upward displacement of the duo-

denum and pressure on the greater curvature of the gastric antrum, with filling defects in the stomach and duodenum. Some evidence of infiltration of the pylorus and in the descending duodenum was noted, and there was marked retention of barium after six hours. These findings were interpreted as probably due to a tumor of the head of the pancreas. Autopsy revealed an annular, polypoid tumor surrounding the papilla of Vater and extending for 6 cm. along the lumen of the duodenum, partly obstructing it. In Case 11 by the same authors, there was irregularity of the second portion of the duodenum which curved far out to the right. In the middle of the first portion of the duodenum, a persistent fleck of barium was noted which was still present six hours later and was interpreted as due to a perforating ulcer of the inferior horizontal portion of the duodenum. Celiotomy disclosed a tumor, 8 cm. in diameter, surrounding the papilla of Vater. In Case 12 by these authors, the stomach was normal. The duodenal cap was greatly enlarged, triangular and regular in outline. The descending portion of the duodenum was irregular and narrowed with retention of barium for more than 24 hours. These findings were interpreted as due to a duodenal diverticulum with partial obstruction and possible carcinoma of the head of the pancreas. Autopsy showed a polypoid tumor surrounding the papilla of Vater but the size of the lesion was not stated. In their Case 16, there was no evidence of ulcer or cancer in the stomach. The second portion of the duodenum, however, showed some deformity considered due to adhesions. Celiotomy disclosed a small, soft, friable mass on the posterior surface of the duodenum close to the papilla. In Cabot's Case 23282, several roentgenologic studies, made two months after the onset of the illness, were all negative. These studies were repeated two months later and showed the stomach slightly displaced to the left and a pressure defect near the tip of the duodenal cap. In the upright position, it was possible to bring only a small amount of barium into the duodenum, and in the horizontal position the duodenum was obscured by the barium filled colon. Reexamination of the duodenum showed a pressure defect at the beginning of the descending duodenum. At celiotomy, the stomach was found adherent to the liver, and with the separation of these adhesions an old perforated pyloric ulcer was uncovered. The autopsy disclosed an ulcerated tumor 3x1.5x0.2 cm. in the region of the papilla of Vater. The roentgenograms were then reexamined, and below the defect in the duodenum a slight irregularity was noted on the medial aspect of the descending duodenum which did not seem to be very constant during the examination, but seemed very definite at this time. There had been an area of rigidity about 3 cm. in diameter along the medial aspect of the descending duodenum where it joined the third portion. On one film, a crater was visible in this area creating the impression of a centrally ulcerated lesion which protruded into the duodenum from its medial aspect. In our Case 15, the stomach and duodenum appeared to be normal, but there was widening of the duodenal loop and considerable stasis in the second and third portions of the duodenum. At autopsy, there was moderate distention of the stomach and proximal half

of the duodenum. The papilla of Vater consisted of a smooth, fluctuant nodule projecting 1 cm. into the lumen of the duodenum, and the immediately surrounding tissue was firm. In our Case 17, there was slight broadening of the duodenal curve with delay in the passage of barium through the second and third portions of the duodenum interpreted as due to some enlargement of the pancreas. At autopsy, the papilla of Vater was enlarged and formed a tumor mass 2.2x1.5 cm.

In summarizing the data from these 16 cases, all the lesions, except Cabot's case, were nodular or polypoid and elevated; six measured 2 to 4 cm. in diameter and four measured 6, 7, 7.7 and 8 cm., respectively. The dimensions of the lesions in the other six cases were not recorded. On the other hand, in the 33 cases in which no lesion of the gastro-intestinal tract was visualized, analysis of the postmortem data showed that the primary neoplasm consisted of a nodule 2 cm. or less in diameter in 18 cases, an ulcer 2 cm. or less in diameter in 7, a nodule 3 to 4 cm. in diameter in 5 and 6 cm. in 1, and an ulcer 3 to 4 cm. in diameter in 7.

Gastric retention was correctly recognized roentgenologically in three cases and gastric dilatation in five. Extrinsic lesions resulting in gastric or duodenal deformities were observed in four cases, due to adhesions in one and cancerous lymph nodes in three. In another case, suggesting the presence of an extrinsic lesion, none was demonstrated at autopsy. A roentgenographic diagnosis of carcinoma of the head of the pancreas, without reasons therefore, was made in one case, but at autopsy this organ showed no visible change. A healed ulcer was, in two instances, correctly visualized in the duodenal bulb, but in four others, suspected lesions of the pylorus or duodenal bulb were not confirmed at autopsy. In two cases, the duodenal bulb was widened, in one of which the pancreas as enlarged and cancerous while in the other it was unchanged. The gallbladder was visualized in two cases but it was not visualized in several others, in all but one of which obstructive jaundice was present, the exception showing calculous cholecystitis.

Diagnosis.—A correct clinical diagnosis was made in 39 cases, in which a tumor was suspected in the common bile duct, ampulla of Vater, papilla of Vater or duodenum. In 62 cases, one or more of the following diagnoses were made: Carcinoma of the head of the pancreas (25); calculous choledochitis (14); calculous cholecystitis (10); obstruction of the bile ducts (12); carcinoma of the stomach (6); carcinoma of the liver (5); cholangeitis (4); cholecystitis (3); carcinoma of the gallbladder (3); and in one case each, catarrhal icterus, carcinoma of the pancreatic duct, ulcer of the ampulla of Vater, ulcer of the duodenum, pyloric ulcer, primary anemia, syphilitic hepatitis, intestinal obstruction due to volvulus or intussusception, neoplasm, chronic nephritis, echinococcus cysts of liver and metallic poisoning. No clinical diagnoses were reported in the remaining cases.

A correct surgical diagnosis of carcinoma of the ampulla or papilla of Vater, duodenum or common bile duct was made in 83 of the 122 cases subjected to operation. In eight additional cases, the diagnosis was correctly made

at a second operation. In 22 cases, one or more of the following diagnoses were made: Tumor of the pancreas (12); calculous cholecystitis (4); noncalculous obstruction of the common bile duct (2); and in one case each, stone in the common bile duct, pyloric ulcer, a mass adjacent to the head of the pancreas and tuberculosis of the papilla of Vater.

Treatment.—The treatment of peripapillary carcinoma of the duodenum has been symptomatic, palliative or directed toward a cure. Radiation therapy was employed in three cases. In Upcott's case, a transduodenal excision of the primary tumor and cholecystostomy were performed, and five days later 5 mg. of radium were inserted and left in place for six hours, this procedure being repeated the following day for four hours. The patient was discharged from the hospital nine days later; no further notes as to his subsequent course were recorded. In Abell's Case 3, cholecystostomy was performed first, then biopsy and cholecystoduodenostomy two months later and, at a third operation, two and one-half months later, 25 mg. of radium were applied to the primary neoplasm in the duodenum for 12 hours. The patient subsequently gained 55 pounds (25 Kg.) in weight but never experienced complete relief from digestive discomfort. He lived for 20 months, however, despite clinical evidences of metastases. Muller's patient received lead intravenously followed by deep roentgenotherapy about three and one-quarter years after the first operation, and five months after the third operation. Death ensued approximately one and one-half years later, or a total of four years and eight months after the first operation, there being clinical evidences of metastases at that time.

Celiotomy was performed in 122 cases, in 86 of which the presence of a tumor in the region of the papilla of Vater was detected by means of external palpation of the duodenum in 59 instances, by opening the common duct and attempting to pass a sound which met with an obstruction in 10, whereas, in 16, the method of recognition was not stated, although it was possible to tell from the description that the lesion was directly inspected by opening the duodenum in 14 of these. In eight of these cases, the tumor, unrecognized at the first operation, was detected at a subsequent operation. Some of the tumors palpated were quite small, being only the size of a pea or lentil. Walters cleverly detected an inconspicuous lesion of the papilla of Vater which would have been disregarded except for the fact that the gallbladder was distended and the possibility of an ulcerating lesion of the papilla suspected as a cause of the intestinal hemorrhage. In 25 cases, the primary tumor went unrecognized at operation, even though it measured in many cases 2 to 3 cm. in diameter and in one, 5 cm. In one case, the tumor was missed at each of three operations. In seven cases, a malignant lesion was thought to be present in the head of the pancreas but this was not substantiated at autopsy. In another case, although a sound introduced into the common duct was arrested lower down, the neoplastic nature of the obstruction was not appreciated. In several cases, the primary tumor was mistaken for a gallstone. In one case in which a biopsy was obtained, an incorrect histologic diagnosis of

tuberculosis was submitted. Other findings were infrequently mentioned. Metastases or extension of the neoplasm was noted in 11 cases, in the regional lymph nodes in all, in the pancreas in two, and in the kidney in one. The peritoneal cavity contained ascitic fluid in four cases. Evidences of cholecystitis were present in 12 cases, in most of which there were pericholecystic adhesions. The gallbladder contained pus and bacteria in a few, and gallstones in eight cases, while of three cases, stones were encountered in the common bile duct in all and in the cystic duct in one.

The operative procedures employed, and the results obtained by the various authors are indicated in Table I. Excision was performed in 57 cases, at the first operation in 47, at the second operation in 10, and in two cases it was attempted at both operations. It was the sole procedure in 15 cases, while in the others it was performed in association with one or more of the following: Anastomosis between the biliary and gastro-intestinal tracts in 26 cases; drainage of the biliary tract in 20; implantation of the pancreatic duct into the duodenum in 8; gastro-enterostomy in 10; cholecystectomy in 5; biopsy in 2; and in one case each, pyloroplasty, pancreaticostomy, duodenoduodenostomy, appendicectomy, implantation of pancreatic duct into common bile duct, insertion of radium and drainage of abdomen.

Of 65 cases, in which the primary neoplasm was not excised, one or more of the following procedures were employed: Drainage of the biliary tract (29); some anastomosis between the biliary and gastro-intestinal tracts (28); biopsy (9); gastro-enterostomy (8); cholecystectomy (7); exploratory (6); and in one each, appendicectomy, drainage of the pancreatic duct, duodenostomy and insertion of radium into the primary neoplasm.

Cholecystectomy was performed in 12 cases, in all of which biliary obstruction was present, and in five, some evidence of inflammation such as adhesions or stones was noted. There was generally no assignable reason stated for this procedure, although in one the primary lesion was mistaken for an impacted stone in the common bile duct, and cholecystectomy was carried out apparently with this idea. In one patient, this procedure was instituted despite the fact that metastatic nodules were present in the liver. In a few, the true nature of the condition was, unfortunately, not appreciated until after the gallbladder had been removed, whereupon, appropriate surgical measures were then instituted. In three cases, simple cholecystectomy was, curiously enough, followed by disappearance of jaundice. This may probably have been coincidental, for the spontaneous disappearance of this symptom occurred in several other instances both with and without surgery. It is, of course, evident that the removal of the gallbladder in these cases does away with a useful viscus for establishing a biliary anastomosis with the gastro-intestinal tract, and, therefore, this procedure may result in real embarrassment under these circumstances.

Little or no reference was made, generally, to the clinical state of the patient after operation. Even so important a feature as the persistence or disappearance of icterus was not commented upon in 31 cases in which sur-

TABLE I

RESULTS IN CASES IN WHICH OPERATION WAS PERFORMED

Year	Author	Operation	Result
1889	Ely	Cholecystostomy	Died 5 days after oper.
1893	Hesper	Cholecystostomy	Died 3 wks. after oper.
1893	Weir	3/8/93: Cholecystostomy; drainage of pancreatic duct	Died 10 days after first oper.
		3/18/93: Cholecystojejunostomy	Died 2 hrs. after second oper.
1900	Butz	11/30/98: Cholecystoduodenostomy	Died 19 mos. after first oper.
		2/20/00: Gastro-enterostomy	Died 5 mos. after second oper.
1900	Dobbertin	Partial cholecystectomy; cholecystostomy	Died 3½ mos. after first oper.
		3¼ mos. later: Cholecysto-enterostomy	Died 8 days after second oper.
1901	Schüller, Case 1	Transduodenal excision; cholecystostomy	Died 5 days after oper.
	Case 2	Cholecysto-enterostomy	Died 12 days after oper.
1901	Rixford	10/22/01: Transduodenal excision; cholecystostomy	Operative recovery
		11/21/01: Transduodenal excision; choledochoduodenostomy	Operative recovery
		7/?/02: Cholecysto-enterostomy	Died 4 mos. after third oper., 13 mos. after first and 12 mos. after second oper.
1901	Mayo	11/3/00: Cholecystostomy	Operative recovery
		1/3/01: Transduodenal excision	Operative recovery
		7/7/02: Cholecystoduodenostomy	Operative recovery; discharged, 20 mos. after first, and 17¼ mos. after second oper.
1902	Scheuer	2/?/00: Cholecystostomy	Died 10 mos. after first oper.
		?/?/00: Exploratory	Operative recovery; discharged
1902	Miodowski, Case 4	Cholecystostomy	Died 1 day after oper.
1902	Hagen	Cholecystoduodenostomy; gastro-enterostomy	Died several hours later
1903	Cornil and Chevassu	Cholecysto-enterostomy	Died 9 days after oper.
1904	Klotz	Exploratory	Died 1 mo. after oper.
1906	Carnot and Harvier	Cholecystostomy	Died several days after oper.; peritonitis
1906	Arnsperger, Case 25	Cholecystostomy	Died 13 days after oper.
	Case 28	Transduodenal excision	Died 2 days after oper.
1907	Verhoogen	Transduodenal excision	Died 11 days after oper.
1908	Devic and Savy	Gastro-enterostomy	Died 36 hrs. after oper.
1909	Körte, Case 32	Transduodenal excision	Living and well 46 mos. after oper.

TABLE I—*Continued*

Year	Author	Operation	Result
1910	Navarro	Transduodenal excision; choledochoduodenostomy	Operative recovery; discharged
1910	Koerber, Case 1	Cholecystojejunostomy	Died 3 days after oper.
	Case 2	Cholecysto-enterostomy	Died 5 days after oper.
1910	Doberauer	Transduodenal excision; cholecystoenterostomy	Died 3 mos. after oper.
1910	Cuneo	Transduodenal excision; choledochoduodenostomy	Died 5 days after oper.
1910	Oehler	Transduodenal excision; cholecystostomy	Living and well 5 wks. after oper.
1912	Upcott, Case 2	5/3/12: Transduodenal excision; cholecystostomy	Operative recovery
		5/14/12: 5 mg. radium inserted into cystic duct for 6 hrs. Same procedure next day.	Operative recovery; discharged
1912	Kausch, Case 2	6/15/09: Cholecysto-enterostomy	Operative recovery
		8/21/09: Radical resection of 11 cm. of duodenum	Operative recovery
		5/25/10: Cholecystostomy	Died 1 day after third oper.; hemorrhage, 11½ mos. after first oper. and 9 mos. after second oper.
	Case 1	Cholecystojejunostomy; duodenotomy	Died 4 days after oper.
1912	Oppenheimer	Transduodenal excision; gastro-enterostomy	Living and well 7 mos. after oper.
1912	Lenormant	Cholecystectomy; choledochostomy	Died 7 days after oper.
1913	Pollet	Biopsy; choledochostomy	Died 8 days after oper.
1914	Crohn, Case 2	Cholecystostomy	Died several hrs. later; shock
	Case 3	Cholecystostomy	Died 1 day after oper.; shock
1914	Zuccola, Case 2	Cholecystostomy	Died 39 days after oper.
1914	Docq and van Bever	Transduodenal excision	Died 4 days after oper.
1917	Pétren, Case 56	Cholecystoduodenostomy; choledochostomy	Died 5 days after oper.
1918	Anschütz	Transduodenal excision; gastro-enterostomy; cholecystostomy	Operative recovery; discharged
1919	Oliani	Transduodenal excision	Living and well 1 mo. after oper.
1919	Schüssler, Case 3 in text.	Cholecystostomy; transduodenal excision; choledochoduodenostomy; gastro-enterostomy	Living and well 4 mos. after oper.
1920	McGuire and Cornish, Case 1	Cholecystostomy	Died 3 hrs. after oper.

TABLE I—*Continued*

Year	Author	Operation	Result
1921	Pallin, Case 1	Transduodenal excision; cholecystostomy; choledochostomy	Died 8 hrs. after oper.; pneumonia; intestinal hemorrhage
	Case 2	Transduodenal excision; cholecystectomy	Died 2 days after oper.; intestinal hemorrhage
	Case 3	Transduodenal excision	Died 3 days after oper.
1921	Carnot and Libert	Cholecystogastrostomy	Died 16 days after oper.
1921	Propping	Transduodenal excision	Living and well 13 mos. after oper.
1921	Lewis	Transduodenal excision; cholecystostomy	Living and well 4 mos. after oper.
1922	Brütt, Case 6	Transduodenal excision	Living and well 9 mos. after oper.
	Case 7	Transduodenal excision	Living and well 18 mos. after oper.
1922	Kleinschmidt, Case 1	Transduodenal excision; cholecystectomy; choledochotomy	Died 8 days after oper.; peritonitis
	Case 2	Tranduodenal excision; cholecystectomy; choledochostomy; implantation of pancreatic duct into duodenum; drainage of hepatic duct	Living and well 6 yrs. after oper.
1922	Tenani	8/?/18: Cholecystoenterostomy	Operative recovery
		9/?/18: Transduodenal excision	Living and well 4 mos. after second oper., 5 mos. after first oper.
1923	Hartmann	Choledochostomy	Died 8 days after oper.
1923	Angeli	Exploratory	Died 12 days after oper.
1923	Pozzi, Case 2	Transduodenal excision; cholecystogastrostomy; choledochotomy	Died 6 days after oper.; peritonitis
	Case 3	Transduodenal excision	Living and well 1 mo. after oper.
1923	Prat, Case 1	Exploratory	Died 25 days after oper.
1924	Pozzi, Case 1	Transduodenal excision; cholecystogastrostomy; choledochotomy	Operative recovery
1924	Abell, Case 3	5/?/20: Biopsy; cholecystoduodenostomy	Operative recovery
		1/?/23: Gastro-enterostomy	Living and well 10 mos. after second oper., 42 mos. after first oper.
1924	Chiray, Benda and Milchovitch	Cholecystostomy	Died 2 days after oper.
1924	Einhorn and Stetten	6/16/23: Cholecystectomy; appendicectomy	Operative recovery
		11/2/23: Biopsy; choledochostomy	Died 1 mo. after second oper.; septicemia, 5 mos. after first oper.

TABLE I—*Continued*

Year	Author	Operation	Result
1925	Konjetzny	Transduodenal excision; implantation of pancreatic duct into duodenum	Living and well 3 wks. after oper.
1925	Hadfield	Cholecystogastrostomy	Died 4 days after oper.
1926	Hingst, Case 1	Cholecystoduodenostomy	Died 5 yrs. after oper.; diabetic coma
	Case 2	Cholecystectomy; cholecystostomy	Died 12 hrs. after oper.
	Case 3	Drainage of hepatic duct	Died 7 days after oper.
1926	Cabot, Case 12063	Cholecystostomy	Died 4 days after oper.
1926	Garcia Lagos, Ugón, and Dominiquez	Transduodenal excision	Died 16 hrs. after oper.
1927	Clar	1/20/22: Transduodenal excision	Operative recovery
		2/6/22: Cholecystectomy	Living and well 5 yrs. after second oper., 5 yrs. 2 mos. after first oper.
1927	Fulde	Transduodenal excision	Living and well 2 yrs. after oper.
1927	Savinych, Case 2	Transduodenal excision; choledochoduodenostomy; implantation of pancreatic duct into common duct	Died 5 days after oper.
1927	Cohen and Colp, Case 1	Transduodenal excision	Died 10 hrs. after oper.
	Case 2	Transduodenal excision; choledochostomy	Died 5 days after oper.
	Case 4	Cholecystectomy; choledochostomy; duodenostomy	Died 19 days after oper.
	Case 5	Cholecystostomy; choledochostomy	Died 8 hrs. after oper.
	Case 8	Transduodenal excision; cholecystoduodenostomy; gastrojejunostomy	Died 4 days after oper.
1927	Del Valle and Brachetto-Brian	Transduodenal excision; cholecystectomy; appendicectomy; drainage of hepatic duct	Operative recovery; discharged
1928	Llambías, Brachetto-Brian and Orosco	Cholecysto-enterostomy	Died 3 days after oper.
1928	Busch	Transduodenal excision	?
1928	Dewis and Morse	Cholecystostomy	Died immediately after oper.
1928	Boston and Jodzis	Exploratory	Died on operating table
1929	Countryman	Cholecystectomy	Died 5 mos. after oper.
1929	Jermain	Cholecysto-enterostomy	Died 4 days after oper.
1931	Muller and Rademaker	5/20/24: Transduodenal excision; choledochoduodenostomy	Operative recovery
		8/17/26: Cholecystoduodenostomy	Operative recovery

TABLE I—*Continued*

Year	Author	Operation	Result
	Muller and Rademaker..	3/11/27: Gastro-enterostomy	Died 22 mos. after third oper., 4 yrs. 8 mos. after first oper., and 2 yrs. 5 mos. after second oper.
1931	Ross and Davie.....	Cholecystostomy	Died 5 days after oper.
1932	Godfrey and Sappington	Exploratory	Died 8 mos. after oper.
1932	Mateer and Hartman,	6/?/28: Cholecystectomy	Operative recovery
	Case 2.....	7/?/29: Transduodenal excision; biopsy; choledochoduodenostomy	Died 22 mos. after second oper., 35 mos. after first oper.
	Case 5.....	Cholecystostomy	Died 2 mos. after oper.
1932	Walters.....	Transduodenal excision; choledochoduodenostomy; pyloroplasty	Living and well 28 days after oper.
1932	Pemberton.....	10/8/24: Exploratory	Died 26 mos. after first oper.
		1/?/25: Transduodenal excision; choledochoduodenostomy; implantation of pancreatic duct into duodenum	Died 20 mos. after second oper.
		9/20/26: Exploratory	Died 6 mos. after third oper.
1932	Judd.....	11/1/28: Cholecystostomy; choledochostomy	Operative recovery
		12/21/28: Transduodenal excision	Operative recovery
		9/9/29: Cholecystogastrostomy	Operative recovery
		4/26/31: Gastro-enterostomy	Living and well 2 weeks after fourth oper., 30½ mos. after first, 29½ mos. after second and 20 mos. after third opers.
1933	Goldberg	Cholecystoduodenostomy	Died on operating table
1933	Bérard, Mallet-Guy and Croizat	12/17/31: Cholecystostomy; choledochostomy.	Operative recovery
		2/13/32: Biopsy; choledochoduodenostomy	Living and well 4 mos. after second oper., 6 mos. after first oper.
1933	Cabot, Case 19191.....	Cholecystogastrostomy	Died 36 hrs. after oper.
1933	Lauwers, Case 1.....	Transduodenal excision; cholecysto-enterostomy	Living and well 46 mos. after oper.
	Case 2.....	Transduodenal excision; cholecysto-enterostomy	Living and well 9 mos. after oper.
1933	Potter.....	Transduodenal excision; implantation of common and pancreatic ducts into duodenum; drainage of common and pancreatic ducts	Living and well 1 mo. after oper.
1934	Santero Case 1.....	10/10/27: Transduodenal excision; choledochoduodenostomy	Operative recovery

TABLE I—*Continued*

Year	Author	Operation	Result
	Santero Case I (*Cont.*)..	3/16/29: Transduodenal excision; implantation of common and pancreatic ducts into duodenum	Died 5 mos. after second oper., 22 mos. after first oper.
	Case 2.....	7/21/28: Transduodenal excision; implantation of common and pancreatic ducts into duodenum	Operative recovery
		10/30/29: Cholecystostomy	Died 4 mos. after second oper., 19 mos. after first oper.
1934	Harbin, Harbin and Harbin	2/?/32: Cholecystoduodenostomy	Operative recovery
		5/?/32: Gastro-enterostomy	Died 9 days after second oper.; pneumonia, 2¾ mos. after first oper.
1934	Swenson and Levin.....	Cholecystostomy	Died 3 days after oper.
1935	Hunt and Budd.....	Transduodenal excision; implantation of common and pancreatic ducts into duodenum; cholecystostomy	Living and well 3 mos. after oper.
1935	Whipple, Parsons and Mullins, Case 1	3/16/34:Choledochoduodenostomy; cholecystostomy	Operative recovery
		5/17/34: Transduodenal excision; pancreaticoenterostomy	Died 30 hrs. after second oper., 1½ mos. after first oper.
	Case 2.....	7/18/34: Cholecystogastrostomy	Operation recovery
		8/21/34: Transduodenal excision; biopsy; duodenoduodenostomy	Operative recovery
		8/29/34: Gastro-enterostomy	Died 7½ mos. after third oper., 9 mos. after first, and 8 mos. after second oper.
	Case 3.....	1/25/35: Gastro-enterostomy; cholecystogastrostomy	Operative recovery
		2/7/35: Transduodenal excision	Operative recovery
		3/25/35: Drainage of abdomen	Living and well 4½ mos. after third oper., 6½ mos. after first oper.
1936	Doub and Jones, Case 2..	Exploratory	Died 7 days after oper.; intestinal hemorrhage
1936	Koch, Case 2.....	Cholecysto-enterostomy	Died a few days after oper.
1937	Geisthövel, Case I 1.....	Transduodenal excision; choledochoduodenostomy; cholecystoduodenostomy	Living and well 6 mos. after oper.

TABLE I—*Continued*

Year	Author	Operation	Result
	Geisthövel, Case II 1	Choledochoduodenostomy	Died 1 day after oper.; hemorrhage
	Case II 8	Cholecystojejunostomy	Died 4 days after oper.
1937	Cabot, Case 23282	Cholecysto-enterostomy; pyloroplasty	Died 4 days after oper.
1937	Hoffman and Pack, Case 3	Duodenotomy; biopsy	Died 11 days after oper.; bronchopneumonia
	Case 11	Duodenotomy, biopsy; gastro-enterostomy; cholecystogastrostomy	Operative recovery
	Case 12	Duodenotomy; biopsy; cholecystostomy	Died 7 days after oper.; bronchopneumonia
	Case 15	4/?/35: Cholecystostomy	Operative recovery
		5/?/35: Duodenotomy; biopsy	Died 3½ mos. after second oper., 4½ mos. after first oper.
	Case 16	Choledochostomy	Operative recovery
		Transduodenal excision, one month later	Died 6 hrs. after second oper., 1 mo. after first oper.
1937	Lieber, Stewart and Morgan	Cholecystogastrostomy	Died 1 day after oper.; hemorrhage
1937	Lieber, Stewart and Lund, Case 1	Cholecystogastrostomy	Died 5 days after oper.
	Case 3	8/29/32: Cholecystectomy	Operative recovery
		12/19/32: Duodenostomy; removal of fistulous tract	Died 18 mos. after second oper., 22 mos. after first oper.
	Case 7	Cholecystoduodenostomy	Died 9 days after oper.
	Case 17	Cholecystogastrostomy; gastrojejunostomy; jejunojejunostomy	Died 3 days after oper.

gical procedures were instituted, designed for the reestablishment of biliary flow. In 39 cases, however, jaundice cleared postoperatively; in one it remained unaffected; in three it increased in intensity; and in 11 it recurred. The time of disappearance of icterus was mentioned in only three cases, being 11 and 15 days and one and one-half months, respectively. Other symptoms noted after various types of operative procedures were pain in 13 cases, chills and fever in 9, vomiting in 7, loss of weight in 8, indigestion in 3 and in one each, nausea, diarrhea and anorexia. In some patients, one or more of these symptoms reappeared together, and frequently served as indications for multiple operations. An analysis of the cause of these symptoms revealed some interesting data. The recurrence of jaundice postoperatively was apparently due to spontaneous closure of the anastomosis between the biliary and gastrointestinal tract in five cases and to biliary tract infection following instrumentation immediately in two and more remotely after excision and anastomosis in three. Symptoms of intestinal obstruction were noted in three cases in which growth of the local lesion produced obstruction of the lumen of the

duodenum, even though relatively wide excision with reimplantation of the ducts had been previously performed in two of these. Recurrence of the tumor and local infiltration no doubt partially accounted for recurrent symptoms, especially pain as in five other cases. White stools in one case and diarrhea in another were ascribed to the absence of pancreatic secretion from the intestine as a result of recurrence of the growth in one, and almost total atrophy of the pancreas in another.

There was a positive, ultimate mortality rate of about 72 per cent, but this figure would undoubtedly be higher if follow-up studies had been more complete. The period of postoperative survival was not specified in a number of instances in which only palliative operations were performed. There were 60 patients who died during the first 13 postoperative days, and one each on the sixteenth and twenty-fifth postoperative days, respectively, thus emphasizing what poor operative risks these patients are. This high surgical mortality can be attributed, in large part, to the magnitude of the surgical procedures in critically ill patients with biliary stasis, chronic hemorrhage, anemia, dehydration and sometimes intestinal obstruction and varying degrees of starvation. Analyzing the data from the view of the postoperative survival alone, it appears that despite the marked difference in pre- and postoperative treatment, the surgeons of to-day are having no better immediate success in operating upon these patients than they had 25 to 50 years ago. No doubt, this can partly be ascribed to the fact that many more patients who are poor risks are now being treated surgically.

Longer periods of survival were recorded in 23 cases, in which the patients died in from one to 60 months, while in 31 additional cases, the patients survived varying periods of time from one to 72 months after which, however, they were not followed. Thus survival periods of six years were reported in one case, of five years in two cases, of four years in two cases, of three years in one case, of two years in five cases, of one year in six cases and of less than a year in the remainder. It is interesting that two patients, followed for 56 and 60 months, respectively, after operation, ultimately died of recurrent carcinoma with metastases as proved by autopsy, while in Kleinschmidt's case, the last clinical examination made six years after operation showed no evidence of recurrence.

Taken as a whole, the patients who survived the immediate effects of operation lived for a total average of two years after the onset of the condition, and a little more than half of these were reported as still alive at the end of this period. A comparison of the preoperative period of illness in the patients who died with those who were reported as still alive and well showed that the former group were ill for an average of about seven months before surgery was instituted, whereas the latter were ill for an average of only two months, thus illustrating, conclusively, the importance of early diagnosis and early treatment. The patients who lived for less than one month postoperatively were ill for an average of about six months before operation.

Carrying the analysis still further some interesting features come to light. Of 51 patients subjected to some type of palliative procedure only for the relief of obstructive jaundice, 39 died during the first 19 days postoperatively; nine survived for one to 60 months, an average of 19 months; and three were still living at the end of four, four and one-half, and 42 months, respectively. Of 57 patients, in whom the primary growth was resected either alone or in combination with other surgical procedures, 17 died in the first two weeks postoperatively; ten died in from two to 22 months, an average of 11 months, and the remaining 30 were still living one to 72 months later, an average of about 14 months. Of nine patients, in whom resection was preceded by some operation for the relief of obstructive jaundice, there were no immediate postoperative deaths at the time of the resection, and four of the patients died at the end of 11 months on the average, while five were still alive at the end of ten months on an average. Of the 25 patients subjected to two or more operations, the immediate postoperative mortality was five at the second operation.

Many difficulties may be encountered in carrying out surgical treatment, as a review of the clinical and the morbid anatomic findings in the present series indicates. The patients were as a rule deeply jaundiced, undernourished, asthenic and had varying degrees of liver damage. The tumor was not limited to a single structure, but directly or indirectly involved adjacent tissues of equal importance to the human economy. Extension or metastases from the primary lesion occurred in at least 45 per cent of the cases in this series, and of 122 patients subjected to celiotomy, extension or metastases were found in about 11 per cent. Obviously, the surgical measures employed in any individual case must depend upon the general condition of the patient, the character and extent of the primary lesion, the presence of extension or metastases and on the degree of biliary, pancreatic and duodenal obstruction. We are entirely in accord with the views expressed by Whipple, Parsons and Mullins on the surgical treatment in these cases. Greater efforts must be expended in reducing the high, immediate postoperative mortality, and the most satisfactory results can be expected only if surgery is resorted to very early in the condition. Jaundice is usually an early symptom, and in patients in the fifth to the eighth decade of life it should always suggest the possibility of carcinoma in the region of the papilla of Vater. Exploratory duodenotomy and direct inspection of the region about the papilla of Vater is to be emphasized, for the primary lesion may be quite small and otherwise escape detection. The prompt appearance of symptoms at the onset, the absence of metastases in many patients observed at celiotomy in the early stages of the condition, and the unusual longevity shown in several cases should favor the successful eradication of the neoplastic process if adequate preparation and wide excision are carried out.

Ninety-seven of the 100 patients not subjected to surgery lived from two weeks to 28 months, or an average of 6.63 months. The period of survival was two weeks to one month (7); about two months (17); three months

(15); four months (9); five months (7); six months (6); seven months (5); eight months (3); nine months (3); ten months (4); 11 months (4); 12 months (7); 17 months (2); 22 months (3); 26 months (2); and 13, 24 and 28 months (one each). In three cases the period of survival was not stated.

SUMMARY

(1) A clinical and pathologic study of carcinoma of the peripapillary region of the duodenum is presented, based upon 17 new cases and 205 reported in the literature.

(2) These cases have been classified as follows:

(I) Primary carcinoma of the ampulla of Vater (one case).

(II) Primary carcinoma of the terminal duct of Wirsung (three cases).

(III) Primary carcinoma of the terminal common bile duct (seven cases omitted from the present analysis).

(IV) Primary carcinoma of the intestinal mucous membrane covering the papilla of Vater (three cases).

(V) Carcinoma involving all the epithelial structures of the papilla of Vater under Groups I, II, III and IV (182 cases).

(VI) Carcinoma involving all the epithelial structures comprising the papilla of Vater, as before, exclusive of the intestinal mucous membrane (33 cases).

(3) Thirteen of our cases and one from the literature, totaling 14 in all, were found in 22,152 autopsies (0.063 per cent), and three cases in 4,154 autopsies (0.096 per cent).

(4) The average age was about 54.4 years, 139 patients being men and 83 being women. Thirteen cases (5.9 per cent) occurred in young individuals, between 15 to 34 years of age.

(5) The onset was acute in about 80 per cent of cases and gradual in 20 per cent. The principal symptoms and signs, irrespective of the mode of onset, were jaundice, pain, loss of weight and strength, anorexia, fever, vomiting, constipation, diarrhea and a sense of weight and pressure in the abdomen. Other less common symptoms were dyspepsia, epigastric distress, flatulency, abdominal distention, nausea and chills. Jaundice was a symptom in 98.2 per cent of the cases, pain in 59.4 per cent, and both were associated at the onset of the condition in 24.3 per cent. Fever, sometimes accompanied by chills, occurred in 33.3 per cent of cases, usually late in the condition. A mass was palpable clinically in the region of the primary tumor in only four cases. The liver was palpably enlarged in 77.9 per cent of cases and the gallbladder in 49.9 per cent. A moderate grade of anemia was the rule in these patients. The duodenal contents contained bile in nine of 15 cases, pancreatic ferments in six and blood in three. The stools were usually clay-colored or colorless and contained blood in 18.9 per cent of cases examined, and occasionally an increase in neutral fats and fatty acids.

(6) A correct preoperative diagnosis was made in approximately 17.1 per cent of cases. The presence of a lesion in the region of the papilla of

Vater was recognized roentgenographically in 16 or 60 cases examined (26.6 per cent). At celiotomy, a correct surgical diagnosis was made in approximately 68 per cent of 122 cases.

(7) The primary neoplasm in Group V (carcinoma involving all the epithelial structures comprising the papilla of Vater) was usually hazel-nut in size and well limited to the papilla of Vater in 73.9 per cent of the 182 cases; and in the remainder, the neoplastic tissue extended into and along the duodenum for varying distances up to 12 cm. in length, the growths averaging 4.5 cm. in length. More than one-third of these tumors were vegetating, papillary or cauliflower-like and rarely filled the lumen of the duodenum. Ulceration of the primary neoplasm was present in 31.3 per cent of cases. Some degree of obstructive jaundice due to involvement of the terminal end of the common bile duct occurred in all but four cases. The terminal end of the pancreatic duct was obstructed in 83.3 per cent of cases in which this structure was examined. Metastases or extension of the primary tumor to adjacent structures occurred in at least 43 per cent of cases. All but four of the neoplasms in this group were of the glandular variety; the exceptions were three cases of adenosquamous cell carcinoma and one of squamous cell carcinoma.

(8) The primary neoplasm in Group VI (carcinoma involving all the epithelial structures comprising the papilla of Vater except the intestinal mucous membrane covering it) was usually the size of a cherry, the papilla projecting forward as a cylindro-conical body into the lumen of the bowel with the mucous membrane covering it smooth, not thickened and usually freely movable. The terminal end of the common bile duct was regularly thickened by an annular growth, grayish-white, usually hard, indurated and measuring as much as 2 cm. in diameter. Elevated tumor nodules studded the mucous surface of the duct in 45.7 per cent, and ulceration of the surface occurred in 12.1 per cent of the 33 cases in this group. The terminal end of the pancreatic duct was obstructed in 83.3 per cent of the 18 cases in which this structure was examined. Metastases and extension of the primary neoplasm occurred in at least 27 per cent of cases. All the cases in this group were glandular carcinomata.

(9) Contrasting the pathologic features of Groups V and VI, certain essential differences were noted. In the latter group, the tumors were consistently smaller and well differentiated histologically, with less anaplasia, all being examples of adenocarcinoma with little or no tendency for the cells to grow in strands, clumps or nests; and mitoses were numerous in only a single case. Metastases and extension of the primary tumor occurred in 27 per cent of the cases of this group as compared with 43 per cent in Group V, and in the former, the intestinal mucous membrane showed no involvement.

(10) Ninety-seven of the 100 patients, treated medically and not subjected to surgery, died on an average of 6.63 months after the onset of the illness.

(11) Surgical therapy was instituted in 122 cases. There was an ultimate mortality rate of 72 per cent but this figure would undoubtedly have been

higher had the follow-up studies been more complete. The operative mortality was 50.6 per cent. Of 51 patients subjected to some type of palliative procedure only for the relief of obstructive jaundice, the operative mortality was 78.4 per cent. Of 57 patients, in whom the primary growth was resected either alone or in combination with other surgical procedures, the operative mortality was 30 per cent. The patients who succumbed immediately postoperatively were ill for an average of six months before operation. Other patients who were operated upon and who survived the immediate postoperative effects lived for a total average of two years after the onset of the condition, and a little more than one-half of these were reported as still alive at the end of this period; of this group, those who died were ill for an average of seven months before operation, whereas those reported as still surviving were ill for an average of only two months before operation. These figures emphasize the importance of early diagnosis and early surgical treatment.

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SURGICAL PROCEDURES FOR CARCINOMA OF THE TRANSVERSE COLON

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THE transverse colon presents certain peculiarities which have led to its being regarded as a distinct problem in intestinal surgery. First, it is the most accessible and most mobile portion of the colon. As it is entirely invested by peritoneum, it lends itself most readily to operative procedures; yet resection of this segment generally is conceded to be attended by a greater mortality[6, 7, 8] than is resection of other portions of the large intestine. Second, it is the portion of the intestine, with the right colon, wherein the fecal matter loses a large part of its water and becomes semisolid. Whether this gradation in physiologic activity has any surgical significance is questionable. Third, the proximity of the greater curvature of the stomach renders this organ liable to early invasion by carcinomata of the left half of the transverse colon.[7, 8] Fourth, because the transverse colon is the connecting link between the right and left portions of the colon, it is resectable by procedures commonly employed in either of these segments, and no general agreement has been reached as to which of the procedures accomplishes resection of this portion of the colon most satisfactorily.

In general, three procedures are available from which to choose the method of dealing with carcinoma of the transverse colon: (1) The transverse colon may be regarded not as an anatomic entity but merely as a continuation of the ascending colon, and may be removed by resection of the entire right half of the colon in one or two stages, with ileocolostomy; (2) a segmental resection may be performed and restoration of the lumen made by end-to-end or side-to-side anastomosis, with or without preliminary or concomitant decompression in the form of a temporary cecostomy or ileostomy; and (3) some form of extraperitoneal resection may be carried out, as first practiced by Bloch, in 1892, and by Paul, in 1895, and popularized by Mikulicz, in 1903. Whether the growth-bearing segment is excised and the ends are exteriorized over glass rods, as practiced by Paul, or the growth-bearing segment of colon is simply exteriorized, as advocated by Mikulicz, or resection is performed with a three-bladed clamp, as suggested by Rankin,[7] the essential feature of the method is avoidance of intraperitoneal anastomosis with its hazard of leakage at the suture line.

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The criticism of the Mikulicz procedure, which is most generally employed, is that it does not allow excision of a generous margin of normal intestine or of the portion of the mesentery that contains lymph nodes; it also leaves a malignant growth in an open wound. Rankin[7] reported that carcinoma recurred in the wounds in 14 of 183 cases in which the Mikulicz operation was employed. Rankin's modification of this procedure, in which the growth-bearing segment of bowel with its mesentery is mobilized, the blood supply is ligated, and the whole segment resected over a three-bladed clamp, seems to avoid these criticisms. It is, however, subject to the criticism that the bowel

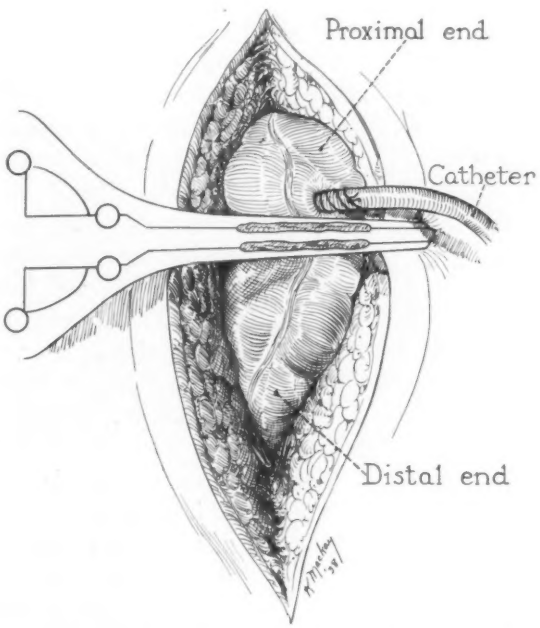

FIG. 1.—Catheter Colostomy: A No. 20 (Fr.) catheter has been inserted into the loop of colon just proximal to the three-bladed clamp and is held in place by a purse string suture. This step is carried out after the abdomen has been closed.

is obstructed, and if it becomes necessary to release the clamp on the proximal limb of bowel before it has become firmly attached to the abdominal wall, there is danger that it will slip back and that the contents will leak into the abdomen or at least into the abdominal wall. This disadvantage has been obviated by one of us (C. W. M.) by employing a catheter colostomy in the proximal limb of bowel just proximal to the clamp; this step is carried out at the time of the resection, after the abdomen has been closed. An outlet is thus provided for the passage of gas and the catheter conveys any fecal drainage away from the wound during its most vulnerable period (Fig. 1). This method appears to be the most satisfactory refinement of the exteriorization procedures to date, but it is still subject to the criticism that multiple

stages are required for the completion of the operation and the satisfactory closure of the resulting colonic stoma.

Segmental resection of the involved portion of bowel with end-to-end or side-to-side anastomosis allows critical evaluation of the amount of bowel on either side of the tumor and the proper amount of mesentery essential to be removed.[7] The operation is completed in one stage, thus obviating repeated operations and a long hospitalization. Criticism of this method has been based upon the fear of peritonitis from leakage at the suture line. Proponents of the extraperitoneal resection[5, 8, 10] have repeatedly stressed its relative safety as compared with that of primary resection and anastomosis. Proponents[1, 2, 3, 4, 6] of the latter method have called attention to the fact that with reasonable care a safe anastomosis can be accomplished and that the intraluminal tension, when obstruction is present, may be avoided by creation of a temporary cecal or colonic stoma either at the time of resection or as a preliminary procedure. Lockhart-Mummery[4] emphasized that the blood vessels which arise from the marginal artery pass around the colon in a circular manner, parallel to each other and perpendicular to the mesenteric border. He noted that sloughing at the suture line always occurs at the antimesenteric border, and said that it can be avoided by cutting across the bowel at an angle of 45 degrees with the mesenteric border, thus insuring a blood supply to the entire circumference of the cut end of the colon.

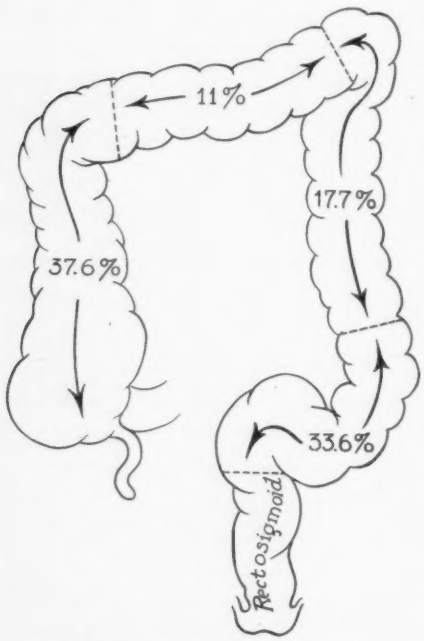

FIG. 2.—Approximate distribution of carcinoma of the colon as encountered at operation, during the period 1907–1936.

In view of the controversial light in which operations on this section of the colon are regarded, it was thought that a study of a rather extensive series of cases in which resection was performed by various methods and analysis of the operative mortality would help to clarify the situation.

A group of 204 cases of carcinoma of the transverse colon has been selected for this study. These comprise approximately 11 per cent of all the carcinomata of the colon, situated above the rectosigmoid, for which operation has been performed during the period 1907–1936. (Fig. 2 and Table I.)

In 57 cases, or 27.9 per cent, the affected segment of the colon was not considered resectable at the time of the exploratory celiotomy (Table I), and in 26 of these cases, some form of palliative operation was performed to

short-circuit the fecal current past the obstruction. This procedure was attended by an operative mortality rate of 35 per cent, whereas in the cases in which only an exploratory celiotomy was performed the operative mortality rate was 13 per cent. Although many of the patients doubtless were made more comfortable by the palliative procedures, the average length of life after operation was not materially prolonged, amounting to six months in those cases in which an exploratory celiotomy, only, was performed and those cases in which some palliative procedure was undertaken in addition. None of the patients in this group survived longer than a year after the operation.

In 147 cases, or 72 per cent, resection of the cancer-bearing segment of colon was carried out with a hospital mortality rate of 20.4 per cent. This percentage compares favorably with that noted in cases in which the carcinoma involved other portions of the colon. In another paper,[9] dealing with 335 cases of carcinoma of the colon, the percentage of cases in which resection was performed was 72.8. The hospital mortality rate in these 147 cases compares favorably with that of 24.4 per cent noted in an unselected group of 197 cases of carcinoma of the colon in which operation was performed during the period 1928–1930, inclusive.[9]

TABLE I

TYPE OF OPERATION PERFORMED IN 204 CASES OF CARCINOMA OF THE TRANSVERSE COLON

Type of Operation	Cases	Hospital Mortality Number	Hospital Mortality Per Cent	Average Stay in Hospital
Exploratory celiotomy	31	4	12.9	
Palliative short-circuiting procedure	26	9	34.6	
Extraperitoneal resection	95	19	20.0	59 days
Resection and primary anastomosis (36 cases, or 17.6 per cent)	36	4	11.1	20 days
Resection of right half of colon and transverse colon, and ileocolostomy (16 cases, or 7.8 per cent)	16	7	43.7	19 days

Some form of extraperitoneal resection was carried out in 95 of the 204 cases (Table I), with an operative mortality rate of 20 per cent. The operation of segmental resection and immediate anastomosis was performed in 36 cases, with an operative mortality rate of 11.1 per cent. The highest hospital mortality occurred in the relatively small group of cases in which the cecum, ascending and transverse colon were resected and an ileocolostomy performed. Of 16 patients who were treated in this manner, seven died in the hospital, a mortality rate of 43.7 per cent. This reflects no discredit on the operation of resection of the right half of the colon when it is performed for lesions not situated beyond the hepatic flexure. It does suggest, however, that this operation is not often applicable to carcinoma of the transverse colon.

These figures suggest that the general impression that extraperitoneal resection is a safer procedure than resection and immediate anastomosis is incorrect, at least so far as the transverse colon is concerned. The objection might be raised that the latter procedure has been employed only in those cases

in which the prognosis is most favorable. The two factors about which we have obtained definite information from the case records and which are most significant of increased operative risk are (1) obstruction and (2) invasion of neighboring viscera. It seems fair to assume that the employment of preliminary or concomitant decompression of the segment of bowel proximal to the resected portion (not including the catheter colostomy just proximal to the three-bladed clamp, as practiced by one of us) indicated the presence of some degree of obstruction.

Such decompression was employed in 12 of the 95 cases in which extraperitoneal resection was performed and in 11 of the 36 cases in which the operation of resection and primary anastomosis was performed; one hospital death occurred in each group of cases in which the latter procedure was used. Even if one assumes that decompression was performed purely as a prophylactic procedure in some of the cases in the latter group, it does not appear that obstruction of significant degree occurred more frequently in the latter than it did in the former group.

In nine, or 9.5 per cent, of the cases in which extraperitoneal resection was performed, portions of neighboring viscera (stomach, ileum or sigmoid colon) had to be resected with the colon, whereas this was necessary in but five, or 13.9 per cent, of the cases in which the operation included resection and primary anastomosis (Table II).

TABLE II

RESECTION OF TRANSVERSE COLON AND PORTION OF ADJACENT VISCUS

Type of Resection	Ileum	Stomach	Gallbladder	Sigmoid Colon	Hospital Mortality
Extraperitoneal resection.....	2	6		1	3
Resection with primary anastomosis.....	1	3	1		0
Resection of right half of colon and transverse colon, with ileocolostomy.....	1	2			2

Since it cannot be demonstrated that either obstruction or invasion of neighboring viscera was more frequent in the cases in which extraperitoneal resection was performed than in those in which resection with anastomosis was effected, it would seem that, except for the possibility of certain intangible factors which did not find their way into the case records, there is no evidence that indicates that the operative risk was lower in the latter than it was in the former group.

An attempt was made to determine the influence of the involved segment of the transverse colon on the type and result of the operation selected. Table III shows the distribution of the growths in the three segments of the transverse colon, the type of procedure employed, and the operative mortality. Extraperitoneal resection was attended by the lowest mortality in carcinoma of the middle segment of the transverse colon and by the highest mortality as the region of the splenic flexure was approached, whereas in this region

the operation of resection and primary anastomosis was employed in nine cases with no deaths.

TABLE III

PORTION OF TRANSVERSE COLON INVOLVED, TYPE OF RESECTION EMPLOYED AND OPERATIVE MORTALITY IN 147 CASES OF CARCINOMA

Segment of Transverse Colon Involved	Type of Resection Employed: Extraperitoneal			Resection with Primary Anastomosis			Resection of Right Half of Colon and Transverse Colon, with Ileocolostomy: One Stage			Two Stages		
	No. of Cases	Deaths: No.	Deaths: Per Cent	No. of Cases	Deaths: No.	Deaths: Per Cent	No. of Cases	Deaths: No.	Deaths: Per Cent	No. of Cases	Deaths: No.	Deaths: Per Cent
Right	19	4	21.0	5	1	20.0	14	6	42.8	1	1	100.0
Middle	33	4	12.1	13	2	15.4				1	0	0
Left	19	6	31.6	9	0	0						
"Transverse colon"	24	5	20.8	9	1	11.1						

Analysis of the operative mortality is shown in Table IV; peritonitis was the most frequent cause of death.

TABLE IV

SURGICAL PROCEDURES IN RELATION TO CAUSES OF DEATH*

Cause of Death	Surgical Procedure: Extra-peritoneal Resection	Resection and Primary Anastomosis	Resection Right and Transverse Colon	Palliative Operation	Exploration
General peritonitis	11	3	2	6	
Separation of suture line		1	2		
Pneumonia	2		3		2
Local peritonitis and ileus	1				
Acute purulent meningitis	1				
Uremia	1				
Hemorrhage and pneumonia	1				
Carcinoma	1			1	2
Ileus				2	
Pulmonary edema	1				

* Total of cases represented in this table does not correspond with total deaths; in some cases cause of death was unknown.

Besides the low operative mortality, what other advantages does the operation of resection and primary anastomosis offer? First, the patient is subjected to the discomfort and expense of only one operative procedure instead of three or four. The surgeon thinks little of the second, third and fourth stages of the Mikulicz procedure, but to the patient each is an operation and therefore an ordeal. Second, the average hospital stay was 20 days for patients who underwent resection and primary anastomosis (Table I), and 59 days for patients who underwent extraperitoneal resection, a difference which may result in consequent financial distress for the remainder of the patient's life. Third, in only two cases in which the operation consisted of resection and primary anastomosis was a fecal fistula present when the patient

left the hospital, whereas the average stay of 59 days in the hospital, calculated for the patient who underwent extraperitoneal resection, does not take into account the weeks, and often months, which elapsed before the colonic stoma was satisfactorily and permanently closed.

These considerations are admittedly secondary; they should not be allowed to influence the surgeon in favor of a procedure less likely to result in the recovery of the patient. Since it cannot be demonstrated that resection with immediate anastomosis is less likely to result favorably than is extraperitoneal resection, the surgeon should look upon these secondary considerations in their true light, that is, as being of great importance from the patient's point of view.

SUMMARY

In 78 per cent of the cases in this series, the involved segment of the colon was resected, with a hospital mortality rate of 20.4 per cent. In 95 cases, the growth-bearing segment of bowel was removed by extraperitoneal resection, with a hospital mortality rate of 20 per cent. In 36 cases, the growth-bearing segment of bowel was removed by segmental resection and primary anastomosis, with an operative mortality rate of 11.1 per cent.

The safety of extraperitoneal resection of the transverse colon as compared to resection with end-to-end anastomosis is so disputable that the surgeon is entitled to be influenced by the greater convenience which the latter type of procedure affords the patient, when, in his opinion, primary resection and anastomosis is a feasible operation.

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SHORT INTERVAL, TWO STAGE THYROID LOBECTOMY FOR HYPERTHYROIDISM

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DURING the past two decades the treatment for the usual case of thyrotoxicosis has become standardized and effective. Differences of opinion still exist concerning the management of so-called severe hyperthyroidism. In neurologic and thoracic surgery, resort to multiple stage operations in critically ill patients has proved to be of inestimable value in reducing operative mortality. Lahey,[8, 9, 10, 11, 12, 13, 14] Crile[1, 2, 3] and others[5, 7, 16] have emphasized and demonstrated this to be true also in thyroid surgery. Such stage operations include ligation of the superior thyroid vessels at one or two sessions followed at a later date by a bilateral subtotal thyroidectomy or by two hemithyroidectomies. In the extremely toxic cases it has been proposed that preliminary dissection and elevation of the skin flaps[11] for partial exposure of the thyroid gland be made a separate procedure. To diminish the operating time the wounds following the extirpation of the gland have occasionally been packed open[2, 3] and sutured a day or two later. The various combinations of these multiple operations, and the time intervals between their performance have been determined largely by a preoperative estimation as to the magnitude of the procedure that could be safely tolerated by the patient, and by the nature of the recovery from each individual stage. It may be fairly stated that, at least so far as the larger thyroid clinics in this country are concerned,[2, 4, 5, 8, 11, 12, 14, 15, 16] the usual procedure has been to perform a hemithroidectomy (which may or may not have been preceded by superior pole ligation), to discharge the patient for a convalescent period of from six to 12 weeks, and then to return him to the hospital for extirpation of the remaining lobe. The relatively long recess between stages was provided in order to allow complete recovery from the first operation and to permit the wound to heal sufficiently so that the second operation could be performed "free from the risk of infection attending the early reopening of a wound."[17] This regimen has several valid objections which have been pointed out in a recent communication by McGraw,[17] and deserve to be repeated and emphasized: "Some of these patients thought they were so much improved by a single lobectomy that they would not return for the second operation. Others waited long beyond the requested interval and returned for the second operation with their original degree of hyperthyroidism fully recurrent. Others found the economic strain made invalidism or even strict rest between operations difficult or impossible, with the result that their condition before

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the second operation was sometimes more precarious than it had been previous to the first."

McGraw has been able to obviate these difficulties by materially shortening the interval between stages and by keeping the patient in the hospital until all the necessary operative procedures have been completed. In his series of 161 cases, the time interval between operations varied from six to 12 days. After bilateral superior pole ligation, and especially after subtotal hemithyroidectomy, he noted rapid clinical improvement. There was, however, no early significant drop in the basal metabolic rate. The operative mortality in this group was 7.5 per cent. Of all the postoperative complications the most frequent and most distressing were wound infections. In 94 cases, in which preliminary superior pole ligation was followed after a short interval by bilateral subtotal extirpation of the thyroid gland through the same wound, there were 22 wound infections. In 48 cases, two separate hemithyroidec-

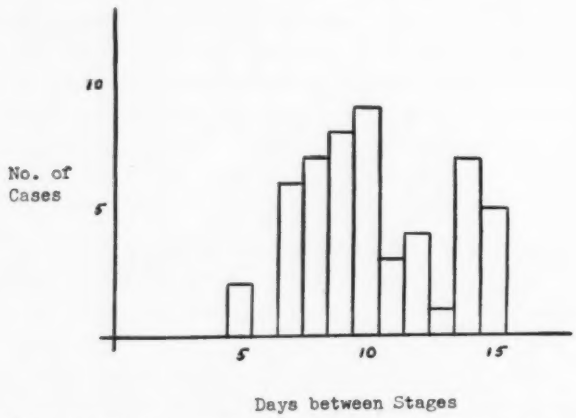

CHART 1.—Graphic representation of the time interval between stages in 52 cases.

tomies were performed through the same wound. In this series, five of the wounds became infected. Thus, in the combined group of 142 cases in which operations were carried out through one wound at intervals of from six to 12 days, there was a total of 27 (19 per cent) wound infections. In the majority of instances these infections were of brief duration and apparently in no way significantly interfered with the convalescence of the patient or retarded his discharge from the hospital. In a few cases they were protracted and severe. In no instance did the wound infection contribute toward the death of the patient.

Since 1921, 52 cases of hyperthyroidism at the New Haven Hospital have had two "short interval" stage operations through the same wound. Save for two instances where the superior poles had been previously ligated through separate incisions in the neck, all the operations consisted of hemithyroidectomies. They were performed by many different members of the full-time staff (attending and resident) during the past 17 years. The interval between

stages varied from five to 15 days (Chart I), the average for the group being 10 days. There were 39 females and 13 males, the ages ranging from 14 to 67 years. In 29 instances, the initial preoperative basal metabolic rate was +50 or higher. The preparation for the operation, practically identical in all cases, consisted of bed rest in quiet surroundings, maintenance on a high caloric diet, and administration of the usual medications including adequate sedatives and daily doses (minims 15) of Lugol's solution. In addition, 28 of the patients were digitalized because of persistently rapid pulse rates or frank signs of cardiac decompensation. In only a few instances was a two stage procedure deliberately planned beforehand. For the most part this decision was made at the operating table after is was noted how the removal of the first lobe had been tolerated.

An attempt has been made to evaluate and to compare the severity of the patient's reaction during each operative stage and each postoperative period. The criteria employed to determine the reaction during the progress of the operation included the maximum and minimum levels reached by the blood pressure, pulse and respiration, and the degree and rate of fluctuation of these signs. Similarly the fluctuations of the pulse rate and temperature were used to estimate the nature of the postoperative convalescence (Table I). During

TABLE I

RELATIVE SEVERITY OF THE REACTIONS DURING AND AFTER THE SECOND STAGE OPERATIONS IN 52 PATIENTS

	Reaction to Second Stage		
Period	Equal to First Stage	Less Severe Than First Stage	More Severe Than First Stage
During operation.....	19 cases	28 cases	5 cases
During postoperative phase...	14 cases	29 cases	9 cases

the latter period any unfavorable events which contributed toward the patient's difficulties were included in the aggregate estimation of the postoperative reaction, no attempt being made to segregate relevant complications such as pneumonia and the so-called thyroid crises from relatively irrelevant ones, those which occasionally followed intravenous administration of fluid or transfusions of blood. The basal metabolic rate during the interval between stages was recorded in 29 cases. In 22 of these, there was a depression following the first operation ranging from five to 42 points, the average drop being 14. In two instances the basal metabolic rate rose six and 10 points respectively. In five no appreciable change was noted.

The technic of the removal of the thyroid gland was patterned after that described by Halsted.[6] A subtotal hemithyroidectomy was first performed through the usual Kocher incision. After an interval varying from five to 15 days, the wound was reopened and the remaining lobe subtotally extirpated. Fine black silk sutures were used exclusively. In this series of 52 cases of two stage thyroidectomies, there were 104 operations. The wounds in 95 of these were closed without drainage. In nine, a superficial rubber slip drain

was introduced and left for 24 to 48 hours (Table II). Per primam healing occurred in a total of 100 of these wounds.* There was one stitch abscess, which subsided rapidly. There were two superficial hematomata, one becoming secondarily infected and draining for several weeks, the other clearing up completely after 24 hours. Of the nine drained cases, eight healed almost at once after the removal of the drain. In one, there was a small sinus tract which closed after three weeks. The group included four cases of recurrent thyrotoxicosis in which the two stage operations were carried out through the scars of the previous thyroidectomies. These wounds, closed without drainage, healed per primam. The infections and hematomata were of minor significance and had no effect on the postoperative recovery.

TABLE II

CHARACTER OF WOUND HEALING FOLLOWING 104 OPERATIONS

Nature of Closure	No. of Wounds	Per Primam Healing	Wound Infections	Hematomata
Without drainage.....	95	92	1 (stitch abscess)	2 (1 infected, 1 subsiding rapidly)
With drainage.....	9	8	1	0
Totals.....	104	100	2	2

There were no deaths in those patients upon whom the two stage procedure had been completed. One death from acute cardiac failure with auricular fibrillation occurred two days after the removal of the first lobe in a patient in whom two operations had been planned. There were no instances of any appreciable tetany. Three postoperative unilateral recurrent nerve paralyses were noted, one occurring following a secondary operation for recurrent hyperthyroidism. There were no instances of bilateral recurrent nerve paralysis.

CONCLUSIONS

The current practice of allowing relatively long lapses of time between operative stages in cases of severe hyperthyroidism has some definite objections which can be surmounted and remedied by materially shortening the interoperative convalescent period. In this series, the short interval stage operations have been demonstrated to be safe, effective and economical. In over one-half of the instances the reactions to the second stage, both during and after the operation, have been milder than those experienced during the first procedure. The operative reaction in 19 cases, and the postoperative convalescence in 14 of them were equal for both stages. In three-quarters of the instances where the test had been made, there was an appreciable drop in the basal metabolic rate between operations. The objection that the early

* In addition, there were four cases of heart disease where two stage total thyroidectomies were performed through the same wound at intervals of five, six, seven, and eight days, respectively. None of the wounds were drained. All healed per primam.

reopening of the thyroid wound is attended by a serious risk of infection is not real. By resorting to fine silk suture material and by avoiding routine and prolonged drainage of the wound, the number of infections should be minimal and should not appreciably exceed that anticipated in wounds through fresh tissues or through old well healed scars.

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SECONDARY DEFORMITIES IN CLEFT PALATE PATIENTS

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THE purpose of this paper is to discuss the problem of secondary deformities in cleft palate patients. Since the treatment or neglect of certain aspects of the primary deformity is so often a factor in the development of secondary defects, a brief survey is made of the accepted methods of treating the original deformities.

There is every reason to believe that cleft palates have occurred in man since time immemorial. A few ancient skulls have been found which have shown these congenital defects. Hippocrates does not mention cleft palates in his writings but later physicians describe them well. Ambroïse Paré termed the condition of cleft lip *"bec-de-lièvre"* or "harelip." He treated palatal perforations (mostly syphilitic) with obturators (Dorrance[3]).

Since Paré's time, two methods of treatment have gradually developed independently of each other. The first method was originated and developed by dentists; the other by surgeons. The aim of these two schools was the same, namely, to cover the palatal defect so as to enable the patient to phonate properly. The dental profession developed ingenious mechanical devices in the form of obturators, while the surgeons constantly improved their technic to effect a joining of the separated borders of the palate.

It appears that the first cleft palate operation was attempted by a French dentist, Le Monnier, in 1766. In general, early surgical attempts did not meet with great success. There were frequent postoperative complications and a somewhat high mortality. The inevitable reaction from these early failures was the stimulation of dentists to develop prosthetic appliances, which, after all, helped the patient to speak quite properly and did not involve a surgical risk.

Surgery, however, was not discouraged by its early reverses. On the contrary, the surgeons became more determined to improve their technic. Their success has been so great that in the last 25 years the construction of prosthetic appliances along the lines of Kingsley,[4] Suerson and others has gradually diminished, and to-day, children with cleft palates are invariably submitted for operative treatment. While the old types of prosthetic appliances are not in use to-day, we shall see later that special prosthetic appliances for the improvement of the facial appearance or speech in secondary deformities play an indispensable part in the treatment of certain types of cleft palate patients. Our surgical technic at present is more simplified and fairly well standardized. The percentage of successful operations is appreciably

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greater at present than even ten years ago, but there are still many unsolved problems.

The first, and most important, problem is the improvement of the speech of the child, and second, the treatment of various secondary deformities of the face and the dental mechanism.

It is true that many children develop those defects in a minor degree so that they are easily corrected. On the other hand, others show marked speech defects and facial deformities as they grow older.

If we consider speech defects first, we recognize that in cleft palate patients they are principally due to inability of the soft palate to completely close the nasopharyngeal sphincter so that it may function adequately. In most cases there is a distinct shortness of the soft palate. In others, the presence of scarring makes the tissues less flexible; still others suffer considerable loss of important tissue following surgical failures. Second in importance to a short and stiff palate are faulty habits of speech and deformities in the dental arch and nasal structures.

Secondary deformities of the nose, the upper lip, the alveolar processes and the hard palate are quite common in many cleft palate patients. These may be slight with minor defects of the nose and lip, or they may be very extensive with gross underdevelopment of the maxillary bones and the dental arch combined with obvious lip and nose defects.

Defects of the nose and lip, no matter how extensive, may be repaired surgically with fairly good results, but the reconstruction of the underdeveloped maxilla is a difficult problem. Retrusion of the upper alveolar processes affects the normal contour of the upper lip, and has a marked effect on the development and the general shape of the nose, and the contour of the upper half of the face. It even influences the contour and growth of the lower lip and the mandible. The lower lip becomes oversized in order to compensate for the deficiency of the upper lip (due to the constant efforts of the child to bring them together) while the lower jaw seems massive in comparison to the upper one. It is a matter of observation that underdevelopment of the upper jaw is usually more marked and more common in cases of cleft palate patients which have been operated upon than in the non-operated patients.

Before we consider the treatment of secondary deformities in cleft palate patients we should realize that only a certain number are due to the shortcomings of present-day surgical procedures. The surgeon and his technic are often blameless. In other words, there are preventable factors and non-preventable factors.

Present-Day Procedures in Operations for the Repair of Harelip and Cleft Palate.—It is at present agreed among the surgeons that the defect of the lip should be closed within the first month after birth, if the baby is healthy enough to be a good operative risk, although reasonable delay does not have a harmful effect, provided the baby is taking nourishment well and is steadily gaining in weight. There are several standard methods of repairing

lips (Mirault, Blair, Rose, Husson, Thompson, Veau, Ladd) but the method that answers the following qualifications should be given preference:

(1) It should involve a minimum amount of operative trauma.

(2) The operative method should be designed toward bringing the separated parts into their normal anatomic position as much as it is surgically possible, so that when the child grows the lip will develop along normal outlines.

(3) For the sake of the immediate result the procedure must not unnecessarily sacrifice skin tissue, because the excision of a piece of skin as small as one-quarter of an inch in length is equal to one-half an inch in length in adult life. A tense lip, besides lacking normal contours, causes undue pressure against the alveolar process of the upper jaw and becomes partially responsible for the retrusion of the upper jaw.

(4) It must include correct approximation of the nostrils as an important element of the surgical problem.

In the repair of a lip with a cleft of the alveolar process and the palate, it was at one time a common practice to bend or fracture the alveolar process of the bony side of the cleft and to approximate it forcibly. That practice is employed very infrequently at the present time. After the repair of the lip, it is found that the constant pressure of the upper lip brings the edges of the alveolar cleft together within a few months.

Failure to obtain a perfect lip and nares at the initial operation is not very serious because the lip and nose are susceptible to secondary operations. But in the repair of the cleft palate, it is important for the patient to have each step succeed. A palate that fails to heal following the initial operation will become much harder to repair the second time, as the failure of the first operation with trauma and infection following means contraction and fibrosis of the tissues with diminished blood supply. Therefore, every effort must be made to try to make the first operation successful.

The weakest point in the present method of cleft palate operations is the creation of a raw granulating area on the nasal side of the hard palate where most of the failures take place. This area is also definitely responsible for an eventual shortening of the soft palate, as the nasal side of the repaired palate, not being covered with epithelial tissue, contracts when healing takes place, the median scar pulling the soft tissues of the velum forward, thus increasing the nasopharyngeal space. Many operative measures are suggested to counteract this phenomenon but as yet no completely satisfactory solution has been found.

Various methods have been used in the past to effect compression of the two halves of the palate nearer together in order to reduce the size of the cleft. Mechanical clamps and surgical procedures have been used for this purpose. However, clamps have been found to be impractical on babies, while surgical methods cause too much trauma and often lead to the loss of teeth, distortion of maxillary arches and various other secondary deformities.

Osteal uranoplasty (W. B. Davis,[2] Dieffenbach) with numerous modifications has been advocated from time to time for the sole purpose of eliminating the raw area on the nasal side of the palate. This method consists in general of fracturing the palate, using plates at pressure points and forcing together the halves of the palate. The objection to this method is that it inflicts excessive trauma.

Flaps of the tissue of the hard palate have been everted to cover the perforation of the hard palate as a preliminary stage to completing the closure of the soft palate (W. A. Lane, Davies-Colley); and occasionally the mucous membrane of the septum is successfully utilized to repair the hard palate clefts. The last method in selected cases has a limited use provided that it is carried out judiciously.

The two-stage or multi-stage procedure (first advocated by Sédillot, in 1863) seems to gain more popularity, as it is a simple method, causes a minimum amount of trauma to the soft tissues, and also lessens the percentage of operative failures. In general, the procedure is as follows: The patient is rehospitalized about one year after the repair of the lip. By this time the borders of the alveolar cleft are usually in contact. In the operation, the mucoperiosteal tissue is elevated from the bony palate through the usual lateral incisions close to the gingival margins of the teeth, and only the hard palate and alveolar cleft are repaired at this time.

At this stage no attempt is made to separate the nasopalatine aponeurosis from the posterior edge of the palate bone. The purpose of this first operation is to close the clefts of the hard palate and the alveolar ridge with a minimum operative trauma. While the raw area created on the nasal side is becoming epithelialized, the firm attachments of the nasopalatine aponeurosis prevent the tissues of the soft palate from being pulled forward. A few months later a second operation is performed and the soft palate is closed.

Infection.—The greatest cause of failure in the cleft palate operation itself is infection, which manifests itself usually after the fourth day following operation. This infection originates in the nasal cavity; therefore, it is important to operate when nasopharyngeal infections are not prevalent in children. Moreover, it is important to admit children to the hospital, for observation; one or two days before operation. The slightest nasopharyngeal infection automatically postpones operation to a more favorable time. In spite of all our precautions, however, a certain number of failures take place, especially among the younger patients.

In older children certain secondary functional and anatomic defects may gradually appear so that watchfulness by the family physician and the parents is important: First, speech defects become apparent as soon as the child learns to speak and here speech training is of great value. The parents themselves can do a good deal at first, but later a professional speech trainer can accomplish more. Second, underdevelopment of the maxillae and irregularities of the teeth often become apparent after the age of three and may grow progressively worse as the child gets older. Formerly no attempt was made

to correct such deformities, but now we know that a good deal can be accomplished by intelligent orthodontic treatment. Such treatment is arduous, painstaking, and costly. Unfortunately, many parents have no resources to carry on, yet orthodontia remains one of the indispensable means of minimizing secondary deformities in children.

Surgical Procedures for Elongation of the Palate.—Thus far an attempt has been made to outline the present-day routine treatment of patients from the time they are born, assuming that all the plans and steps of the attending surgeons are successful. Unfortunately, these ideal conditions are not always obtainable. Failure in any of the steps in this long series may leave its permanent mark on the growing child. Hence, there is almost invariably the occurrence of secondary deformities in cleft palate patients. Fortunately, however, various methods are being developed to correct such deformities which have given encouraging results.

The secondary defects of the lip and nose are invariably repaired surgically. This is also true in most secondary defects of the palate. If there is no undue amount of tissue loss, the palate can be elongated and the speech improved (Dorrance's "push-back"; Brophy,[1] Halle, Ernst). In adults when there are gross underdevelopment of the maxilla and irregularities of the teeth, perhaps combined with a great loss of palatal tissue from previous operations, we are obliged to combine certain operative procedures with the use of prosthetic dental appliances and by this means obtain satisfactory results.

Treatment of Secondary Deformities of the Nose, Lips, and Maxilla.—Deformities of the nose, lips, and maxillary bones are common in adult cleft palate patients. The degree of deformity varies. Frequently one part is more deformed than the other; one should, however, before repairing the existing defects, make a general survey of the entire problem and draw up a definite plan of reparative procedures. This survey often reveals the necessity for various complex operative and dental procedures which have to be carried out if desirable results are to be obtained.

I. *Deformities of the Nose.*—In cleft palate patients nasal deformities are difficult to classify, but the majority of them may be grouped under the following types:

(1) Distortion and flatness of the nostril on the side of the original defect (Fig. 26).

(2) In addition to the above, the entire nose may be bent to one side owing to the peculiar development of the nasal bones and the septum.

(3) A broad and flat tip, often seen in bilateral cleft lips characterized with short columella (Figs. 2 and 21). If we add to these the individual, racial and family characteristics manifested in the development of the upper part of the nose, we find a very large number of variations in the size and shape of the nose in cleft palate patients.

It is important to study the anatomic peculiarities of the definite deformity we intend to correct. In the distorted and flat nostril we find the floor of

the nostril broad, the wing stretched out, and the contour of the deformed side of the tip at a lower level caudally while the outline of the nostril in general is entirely out of line in comparison with the normal side.

The following general operative procedures, with modifications according to the peculiarity of the case, have been employed in such patients.

A. *Resection of the Septum.*—This is often found to be necessary because of marked deviations. It establishes an efficient breathing space and increases the nasal resonance, thereby improving the tone of the voice, and it is an essential preliminary step toward restoring the deviated nose to the median line, which is accomplished by fracturing the nasal bones along the maxillary processes.

B. *Shaping the Entire Nose to a More Harmonious Contour.*—In this respect we utilize numerous operative procedures commonly employed for the correction of malformed noses. It may be necessary to reduce an oversized hump of the nose to a straight line, or to narrow the tip, or perhaps to shorten the nose. Occasionally it may be necessary to resort to transplantation of cartilage or bone in order to gain the desired contours.

C. Finally, the most important step is the correction of the distortion of the nostril itself, which is really a typical cleft palate deformity, yet we must try to correct it with due regard of the other defects of the nose in order to get good cosmetic results.

The procedure employed for correction of the distorted nostril consists of making a curved skin incision, freeing the wing of the nostril from the base of the nose (Fig. 1A and B). A vestibular incision is now made bilaterally along the anterior border of each of the lower lateral cartilages. Each incision is carried vertically down through the lower border of the septum. The skin over the tip and lateral cartilages and nasal bones is undermined and freed from the nasal framework. The tip of the septum and the median crus of each lower lateral cartilage are exposed. Here one finds that the lateral cartilage of the deformed side is situated at a lower level (Fig. 1A). It is carefully dissected from the septum. Necessary trimming is done on both tips of the lateral cartilages and these are sutured together at an even level. If the tip of the nose is broad, with overdeveloped alar cartilages, it is possible to make a pointed tip by making two parallel incisions, one through each crest of the alar cartilages about 5 to 10 Mm. from the median plane (Fig. 1C). Two medial cartilage flaps are raised by carefully dissecting them from the mucous membrane of the nose and joining them together in a vertical position with catgut sutures (Fig. 1D and E).

Narrowing the base and improving the contour of the wing are accomplished by rotating slightly the incised wing and suturing the inner edge to the side of the septum (Fig. 1F). In order to bring the wing of the nostril to its assigned position, it is found necessary to excise a triangular piece of skin from the upper part of the nasolabial line and to suture the borders in a horizontal line. This procedure immediately eliminates the raw area caused by the medial transposition of the nasal wing (Fig. 1F and G). A final

procedure is needed to be employed in order to raise the upper margin of the nostril which, although improved by the various manipulations described above, still remains out of harmony with the normal side. For this purpose we have tried various means but have found that excision of a semilunar piece of skin, about 3 Mm. above the margin of the nostril, is the most satisfactory method (Blair). The external scar made on the tip of the nose is not conspicuous and it has been a satisfactory procedure (Fig. 1F and G).

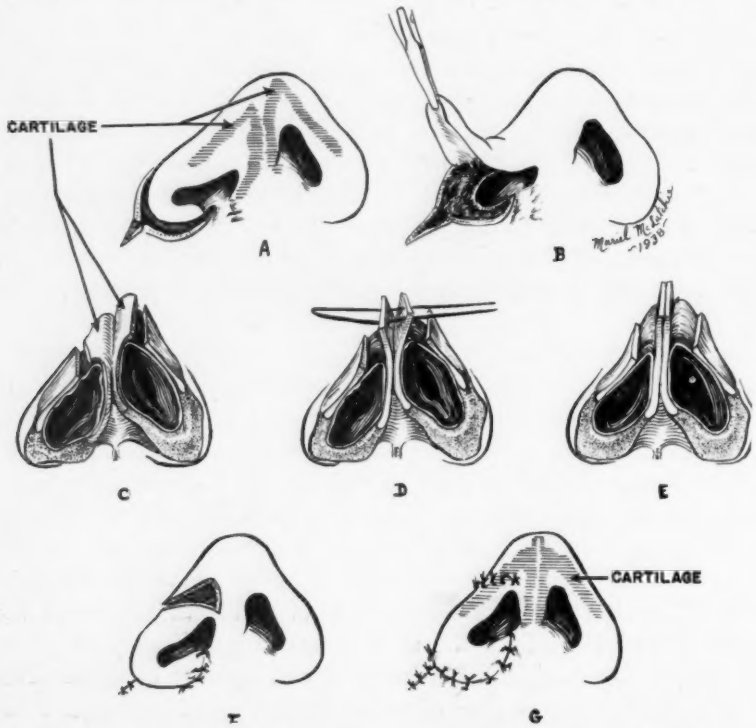

FIG. 1.—Diagram showing the various steps in operation for the correction of distorted nostril as seen in cleft palate patients.

Treatment of the Flat Tip in Bilateral Cleft Cases.—The correction of the broad and flattened tip of the nose, often seen in adults who have had bilateral harelip operations previously, presents an interesting surgical problem. These patients often have, in addition, marked retrusion of the upper jaw with flat, retracted upper lips. The flatness of the tip is caused mainly by the shortness of the columella. The alar cartilages are well developed horizontally, giving the nose an unnatural appearance.

We have not been able to develop uniform surgical procedures to correct these noses but the following principles have proved to be of value: (1) Increasing the vertical diameter of the columella; and (2) narrowing the tip of the nose.

To elongate the columella, two methods are employed: (1) If the nose presents a picture similar to that in Figure 21, where the broadness of the

nostrils is especially evident in a high plane and not at the base, the skin of the lip in the medial part may be utilized to increase the length of the columella. This is accompanied by exposing the alar cartilages through bilateral intravestibular incisions. Two parallel incisions are made in the crests of each alar cartilage, one on each side of the median plane at a distance

FIG. 2.—Photograph of patient with double hare lip and cleft palate. Note the broad, flat tip of nose, typical in bilateral cleft lip cases; characterized by shortness of columella.

of 5 to 10 Mm. The medial part of each alar crest is then dissected free from the underlying mucous membrane and sutured to its fellow in a vertical position in the median line. This raises the tip of the nose and narrows it (Fig. 1C, D and E).

(2) In the type of nose where the breadth of the nose is greater at the base itself (Figs. 2 and 3), a butterfly incision is made as an inverted flat

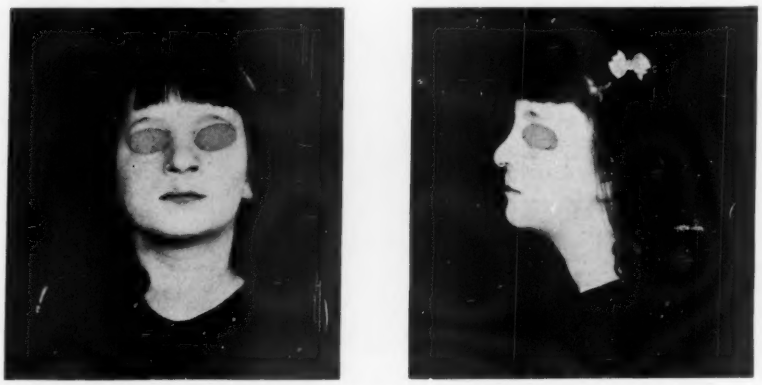

FIG. 3.—Postoperative photograph of patient shown in Figure 2.

V with its point in the columella and the legs of the incision along the nasolabial junctures. Through this incision extensive undermining is carried out under the plane of each nostril and along the sides of the septum. The alar cartilages are exposed as described above and the tip is narrowed. The tip of the nose is now raised by elevation and the columella resutured to the septal tip in the new position (Fig. 4). If sufficient skin is not readily

available to cover the created defect of either the columella or the lip, a full thickness transplant of skin is used to supply the deficiency. This is especially important when the upper lip is already too flat and tight.

II. *Repair of the Lip and Jaw.*—Minor defects of the upper lip in cleft palate patients, irregularity of the lower border or distorted conditions of the vermilion border are readily repaired surgically provided that the underlying support, the teeth and alveolar processes are well developed and normal in outline. In gross deformities with pronounced retraction of the lip, the principal cause of deformity lies in the retarded development of the upper jaw and distortion of the teeth. Such deformities must be studied carefully and treatment extended first to the jaw and then to the lip.

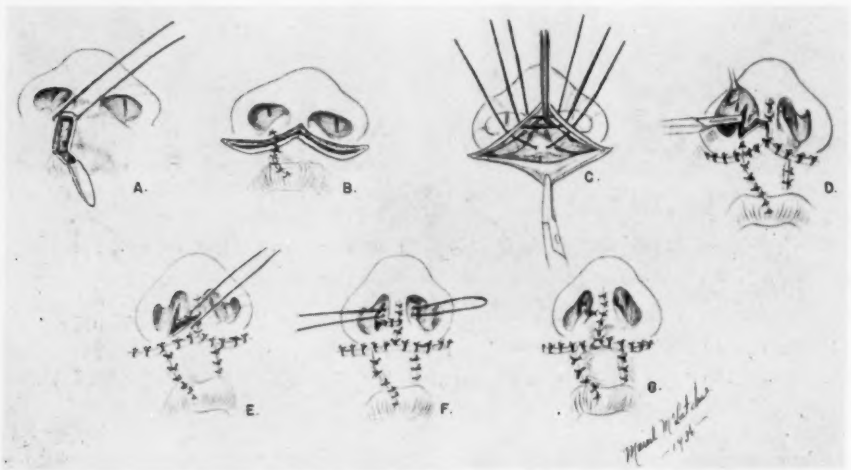

FIG. 4.—Diagram showing the various steps in operation for correction of the flatness of tip of nose. (Case shown in Figure 2.)

Our procedure in such cases is to make a careful inspection of the teeth and jaw. Usually the further plan is as follows: (1) Instruct the patient to go to his dentist and have all the decayed teeth repaired or removed. (2) In some favorable cases, refer the patient to an orthodontist for regulation of the teeth. If the patient is young, regulating of the teeth, especially the posterior ones, is most desirable. The orthodontist has a tendency to think in terms of individual tooth movement and may miss the larger problem present in the cleft palate cases. Some patients have V-shaped arches which actually present an overlapping of the maxillary bones. These cases to my mind should be treated by first spreading the maxillae apart. A gap may develop in the alveolar process or there may develop a nasal perforation, but these can be repaired surgically. The alveolar process may thus be better aligned and a better occlusion of the upper and lower teeth, especially the posterior ones, be obtained.

Most adult patients are not suitable for orthodontic treatment. In such cases the anterior teeth, which are mostly badly distorted, are extracted and

the dentist is instructed to make a special denture with artificial teeth occluding properly in front of the lower central incisors, disregarding the temporary effect on the contour of the upper lip. Not until this stage of treatment is any effort made to repair the lip.

When we study a badly retracted upper lip, we find that in addition to the lack of support from the upper jaw, it is bound down by scars along the bucco-alveolar fold. The principal aim of surgical treatment consists of releasing all of these adhesions so as to allow a dental plate to act as a substitute support to the upper lip and the side of the face.

The surgical procedures are carried out frequently under local anesthesia. An incision is made along the buccal fold as high as possible over the anterior as well as the sides of the upper bucco-alveolar ridges. Hemorrhage is controlled and the area covered with a skin graft. The dental plate with the addition of some soft dental compound along its upper and anterior

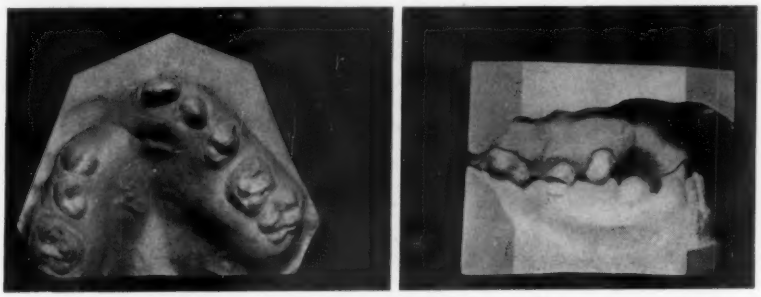

FIG. 5.—Case 1: Photograph of models of teeth.

borders is made to conform to the outline of the new raw area, and acts as a carrier for the Thiersch graft.

A successful skin graft is possible if one pays careful attention to certain details in the procedure. The first is to obtain complete hemostasis; and the second is to obtain complete security of the carrier or plate and the skin graft within the oral cavity.

Another procedure which has helped us a great deal in restoring the upper lip to a presentable contour (the Abbe operation) consists of transferring a triangular piece of lip tissue from the center of the lower lip to the upper. This method is especially suitable in patients who have a tense, more or less atrophic upper lip but have an overdeveloped lower lip. It gives acceptable fulness of the upper lip, in the meantime reducing the size of the lower lip (Fig. 19A, B and C).

ILLUSTRATIVE CASE REPORTS

Case 1.—E. P., male, age 15, was born with a complete cleft of the palate and a [illegible]re-lip. The lip was repaired when the patient was a few days old, and later this was followed by operation upon the palate. When the third operation was performed the patient had a very stormy convalescence; therefore, no further operations were undertaken for the correction of secondary defects, although he had been having orthodontic treatment since 1914.

Examination, April 6, 1936, showed a markedly retracted upper lip (Fig. 6); but the outline of the vermilion border was good. The retraction of the lip was due to extensive underdevelopment and distortion of the maxillary bones. This condition was accentuated by the overlapping of the alveolar ridges. The teeth were irregularly aligned and had no

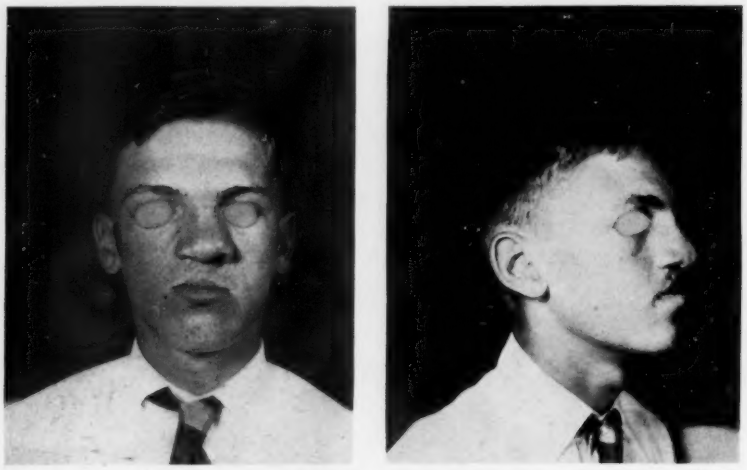

FIG. 6.—Case 1: Preoperative photograph. Note the broadness and distortion of the nose, and retrusion of the upper lip.

contact with the lower teeth except in the molar regions (Fig. 5). There was a small perforation of the hard palate while the soft palate was short. However, the patient had an unusually good speaking voice. The nose was large, thick, and broad and the nostrils wide (Fig. 6).

FIG. 7.—Case 1: Postoperative photograph with denture in position.

The patient was advised to continue the orthodontic treatment, but entirely different plans were outlined, in order to spread the two halves of the upper jaw, thus allowing the molars and bicuspids to come into contact with the lower ones, disregarding entirely the position of the anterior teeth, which were later extracted and an artificial denture

inserted. While the teeth were being regulated, it was considered advisable to operate and correct the deformity of the nose.

First Operation.—July 13, 1936: Under avertin and ether anesthesia, bilateral vestibular incisions were made, 4 Mm. from the border of the nostrils. This incision was carried through the lower border of the septum. Through this approach, the skin over the entire nose was undermined and the lower lateral cartilages exposed. Two lateral cartilage flaps were made on each side and these were sutured in a vertical position. The nasal bones were fractured along the side of the maxillary processes and then pressed together.

Subsequent Course.—The patient reported again July 1, 1937. The contour of the nose had improved materially, although it was still too large and the nasal bones were thick and broad. In addition, he had developed postoperative stenosis of the right nares along the incision line. The orthodontic treatment of the teeth was progressing satisfactorily. By this time it was evident that the remaining anterior teeth could not be utilized properly. It was decided to operate again for the repair of the stenosis of the nares and further improvement of the contour of the nose.

FIG. 8.—Case 1: Postoperative photographs.

Second Operation.—July 3, 1937: Under avertin and ether anethesia, the stenosis of the right nasal passage, caused by a web, was corrected by a Z incision and transposition of the two triangular flaps. The prominence of the bony bridge was reduced by removing, with a rasp, a sufficient amount of bone, through a vestibular incision.

Subsequent Course.—When seen August 30, 1937, it was considered advisable not to carry the regulating of the teeth any further. The expansion of the dental arch had increased the size of the palatal perforation.

Third Operation.—September 8, 1937: (1) Removing three upper anterior teeth, two of them being impacted near the floor of the nose; (2) repairing the perforation by suturing the borders together, after freely undermining the tissues of the palate; (3) elongating the soft palate by making a broad T-shaped incision through the median line and along the edge of the hard palate. The two flaps were then sutured in an overlapping position; (4) an incision was made along the anterior buccal fold and with a blunt dissector a deeper buccal commissure was created. The resulting raw area was covered with skin graft and held in position with appliances especially made for this purpose. The object of this operative procedure was to free the upper lip from adhesions and to give it more fulness. The prosthetic denture which was made also aided in producing this fulness (Fig. 7).

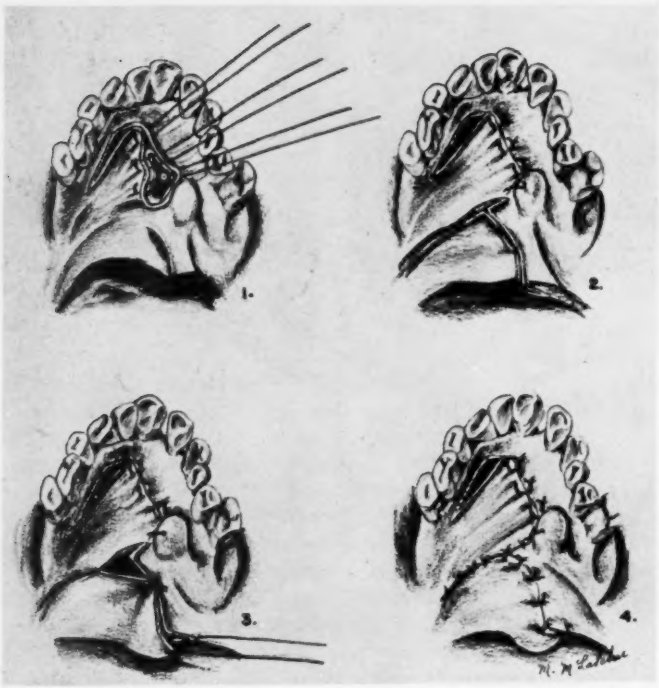

FIG. 9.—Case 2: Model and diagram showing the method of closure of perforations of the palate, combined with elongation of the soft palate.

Following his discharge from the hospital, a new upper denture was constructed and inserted in the patient's mouth (Fig. 8).

Case 2.—H. N., male, age 36, had a congenital, partial cleft extending anteriorly to the premaxillary bone but not involving the alveolar ridge. He had been operated upon in childhood for the repair of the defect.

Examination showed two perforations of the palate, one about 15x5 Mm., at the junction of the hard and soft palate; while the other was about 5x5 Mm., on the left side of the soft palate. In addition, the soft palate was short and as a result, the nasopharyngeal space was quite large. The tissues covering the palate looked quite healthy, but the surface was irregular. His speech, however, although nasal, was easily understandable.

Operation.—September 21, 1936: He was operated upon for the closure of the per-

FIG. 10.—Case 3: Photograph of model showing the extent of palatal cleft.

forations and elongation of the soft palate. Infiltration with a sufficient quantity of a 2 per cent novocain solution resulted in complete anesthesia of the entire operative field. The anterior perforation was closed by a rectangular flap of mucous membrane taken from the right side of the palate (Fig. 9). The closure of the posterior perforation was combined with the elongation of the soft palate. An incision was made beginning from the left side of the uvula, passing through the perforation to the edge of the hard palate, and from there laterally toward the intermaxillary space, down to the post-tonsillar region. The flap of tissue was brought down to the left side and sutured into a new position to the posterior border of the hard palate and laterally to the left side of the soft palate and to the posterior pillar. This procedure practically consisted of overlapping the two halves of the soft palate. The closure of the perforations, combined with the elongation of the palate, improved the phonation of the patient very materially.

Case 3.—C. McG., female, age 22, was born with complete, left-sided cleft palate and harelip. She had been operated upon several times in childhood for the repair of the lip and palate defects. Undoubtedly, she must have suffered extensive infection and sloughing

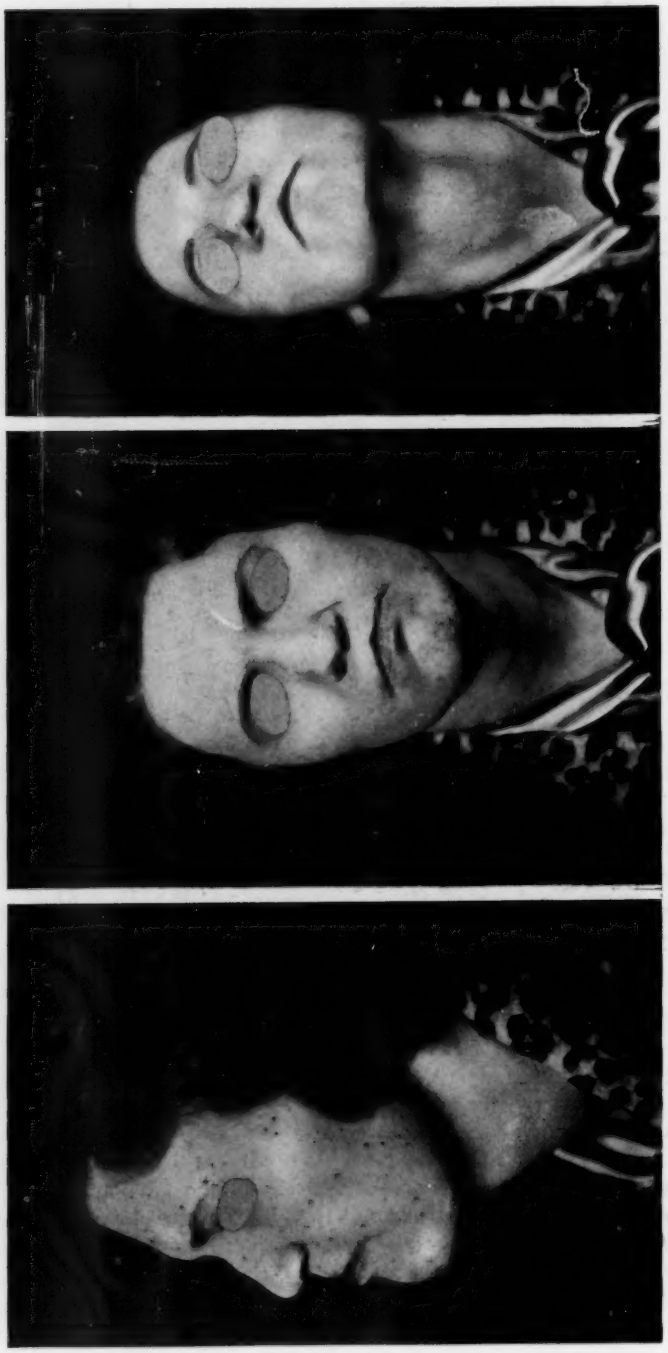

FIG. 11.—Case 3: Preoperative photographs.

FIG. 12.—Case 3: Postoperative photographs.

of the tissues of the palate, as examination, October 16, 1934, showed a very wide cleft with destruction of soft and bony tissues of the palate, including the muscular structure of the soft palate (Fig. 10). The contour of the upper lip was fair except for a slight shortness of the median line and distortion of the vermilion border. The nose was more or less distorted (Fig. 11). The tip was broad and flat, and the nostrils uneven, the left side being defective. The patient was wearing an artificial denture with a poorly made obturator. The denture failed to give the proper fulness to the lip while the obturator was made of soft vulcanized rubber and extended to the posterior pharyngeal wall and caused considerable irritation to the tissues of the pharynx. Her speech was poor, nasal in tone, and hard to understand. The patient had a rather irritable temperament, although she was of average intelligence and quite cooperative.

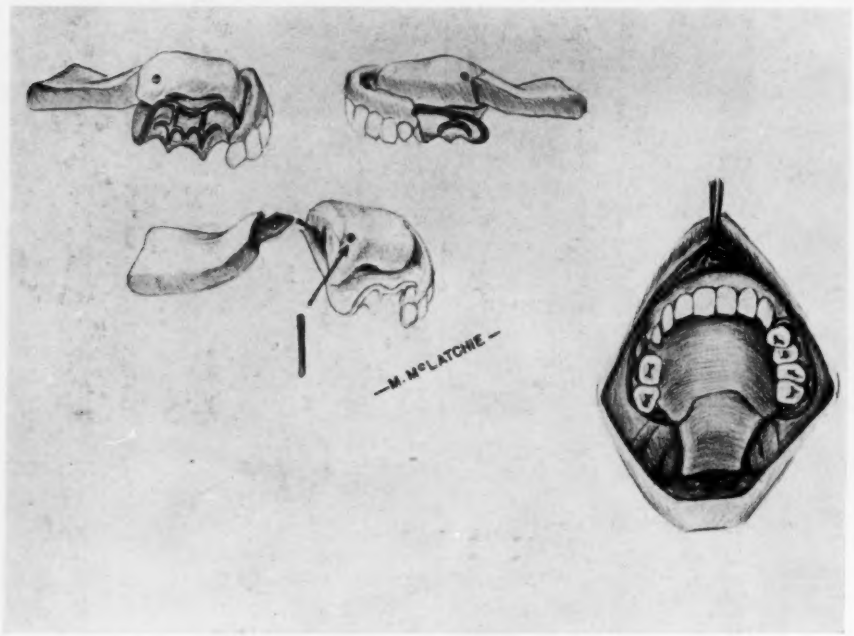

FIG. 13.—Case 3: Diagram showing artificial denture combined with obturator.

It was decided to adopt the following plan of procedure: (1) To repair the nose and lip, surgically. (2) To construct a new artificial denture and obturator, as operative repair of the palate was surgically impractical.

She was operated upon four times between October 24, 1934, and April 16, 1936. In the first operation an attempt was made to shorten the nose and elevate its tip. However, this was not sufficient to give the proper contour to the tip; therefore, in a later operation, rib cartilage was transplanted, which greatly improved the appearance of the nose. The other two operations consisted of improving the contour of the upper lip and relieving the anterior buccal fold of adhesions so as to allow the artificial denture more space and also bring the upper lip forward (Fig. 12).

While the patient was recovering from these operations, preparations were made for the construction of the artificial denture and obturator. It was necessary to extract the existing upper anterior teeth, and this made it possible to make the desired type of denture that would give the proper fulness to the upper lip. The obturator, as shown in Figure 13, had prolongations of the dental plate toward the pharynx but was shaped so

as to be in harmony with the movements of the pharyngeal muscles. Following the construction of the obturator, the patient received intensive speech training from a competent instructor. When last seen, June 29, 1936, there had occurred a remarkable improvement in her speech.

Case 4.—I. B., male, age 25, was born with a double harelip and cleft palate. He had previously been operated upon four times for the repair of the lip and palate defect; and while the lip had held together, the palate had failed to unite. Examination, September 10, 1929, showed irregular scar lines extending from each nostril down toward the center of the upper lip. These scars were partly covered by his mustache. There was a definite

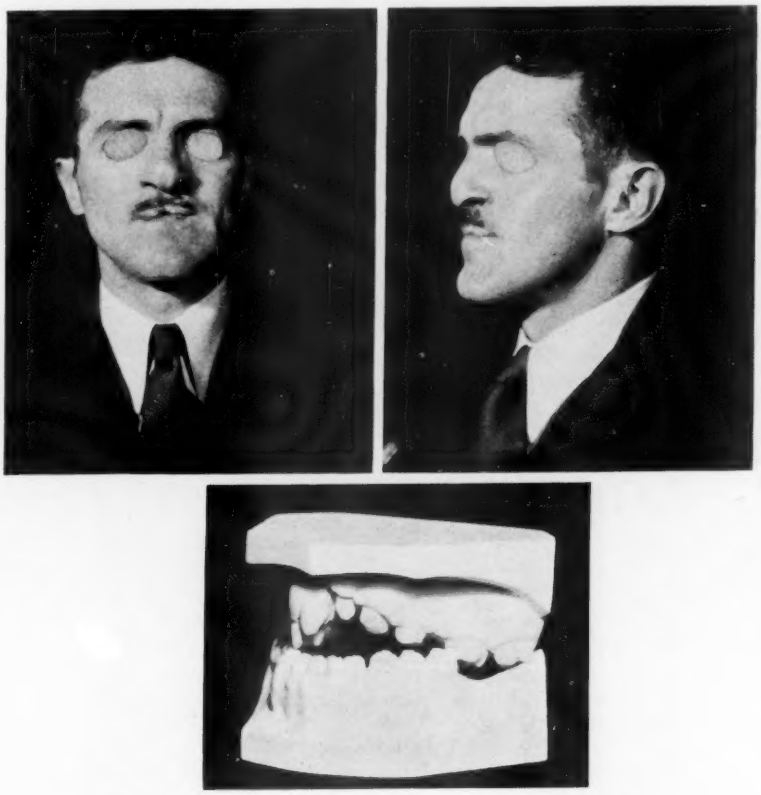

FIG. 14.—Case 4: Preoperative photographs and model of teeth.

V-shaped notch at the vermilion border of the upper lip. The columella, being short, drew the tip of the nose down. The upper lip was markedly retracted, which became more accentuated when the patient brought his upper and lower teeth together. The septum of the nose was deviated to the left and the nostrils were wide and distorted. There was a complete cleft of the palate. The cleft was wide, and the tissues forming the soft palate were contracted and more or less atrophied. The patient had marked retrusion of the upper jaw and the upper arch was V-shaped (Fig. 14).

The following plans were carried out in the treatment of his case:

(1) On May 6, 1931, the upper anterior teeth were removed, including the two upper centrals and the two cuspid teeth. One of the centrals was badly misplaced and found to be protruding through the floor of the nose.

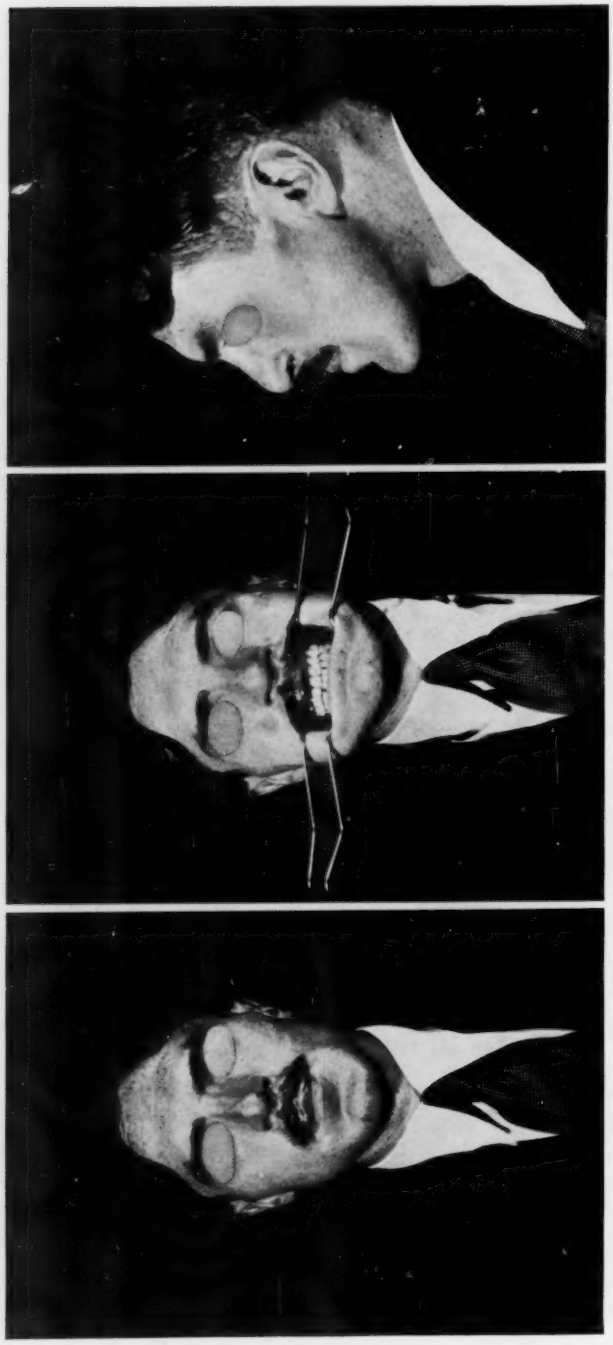

FIG. 15.—Case 4: Postoperative photographs, showing denture in position.

(2) On May 20, 1931, the palate was operated upon under general anesthesia. As it was obvious that there was not enough tissue to cover the entire cleft, it was decided to utilize the existing tissue to reform the soft palate, leaving the anterior perforation to be covered by an artificial denture. Soon after the operation a temporary base-plate was made to cover the anterior perforation of the palate.

(3) On June 18, 1931, the patient was operated upon under local anesthesia. The scars of the upper lip were excised and the V-shaped space in the midline of the vermilion border was eliminated by making a diagonal incision and overlapping the mucous membrane. In addition, free undermining was done above the fold of the upper lip in order to raise its contour. The mucous membrane of the mouth was utilized to cover the raw space on the buccal side. Dental composition was added to the patient's dental plate and pressed against the buccal fold to give additional control of the lip.

(4) On March 23, 1932, the appended operation was performed at the Massachusetts Eye and Ear Infirmary under local anesthesia.

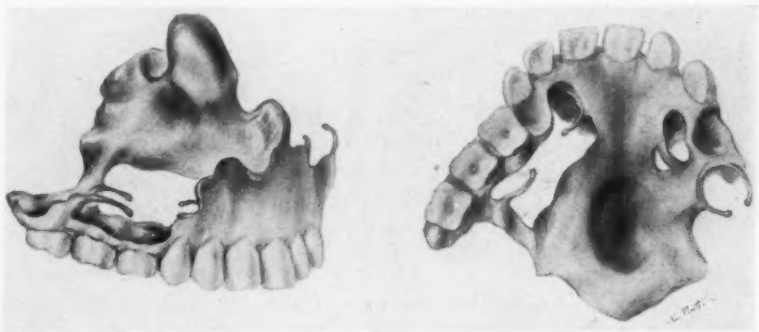

FIG. 16.—Case 4: Drawing of artificial denture. In making this special denture, in addition to supplying the anterior teeth, the bite was raised to increase the contour of the lower part of the face.

The operation consisted of making a double wing incision along the tip of the nose, which was carried vertically down the center of columella and then spread on either side to the base of the nose. Lateral cartilages were rearranged to give a more pronounced tip, and the columella was raised after undermining the septum, floor of the nose, and lateral side of the cartilages. Thus the whole tip of the nose was raised into position and held together with sutures and a gauze dressing. The right side of the upper lip was more pronounced, so a section of it was removed in order to even it up with the other side. The soft palate was short, and an attempt was made to elongate it by suturing the posterior pillars together (Fig. 15).

A permanent prosthetic appliance was made which was constructed to cover the anterior perforation, and in the meantime it was necessary to raise the bite over 8 Mm. in order to get a better facial contour. The appliance had enough bulk, anteriorly, to give a better contour to the outline of the upper lip. The denture is illustrated in Figure 16, and shows that the artificial teeth in the molar region actually rested upon the cusps of the natural teeth.

In addition to the improvement of the facial contour, at completion of treatment, the patient also had a marked improvement in his speech.

Case 5.—W. N., male, age 37, had congenital bilateral harelip and cleft palate. He was operated upon in childhood for the repair of the lip only. The patient was edentulous, yet was able to use a well-made upper denture with an obturator attached to it. The upper lip was markedly tense with scars, and considerably retracted, while the lower lip appeared

over-sized. The general contour of the nose was good, except that the tip was broad and the nostrils broad and irregular in outline (Fig. 17).

Three operations were performed, under local anesthesia, for the repair of the lower part of the nose and the lip. For the repair of the lip, it was decided to transfer a triangular flap from the middle of the lower lip to the upper, in two stages (Fig. 19A, B and C).

FIG. 17.—Case 5: Preoperative photographs. Note the tense, retracted upper lip, and the broad outline of lower part of the nose.

The operation upon the nose consisted of: (1) Elongating and narrowing the columella; (2) making the tip of the nose less wide by exposing the lower lateral cartilages and trimming the cartilages on each side; and (3) excising a semilunar section of tissue from the base of each wing of the nostrils (Fig. 18).

Case 6.—F. S., female, age 30, had congenital bilateral harelip and cleft palate. The

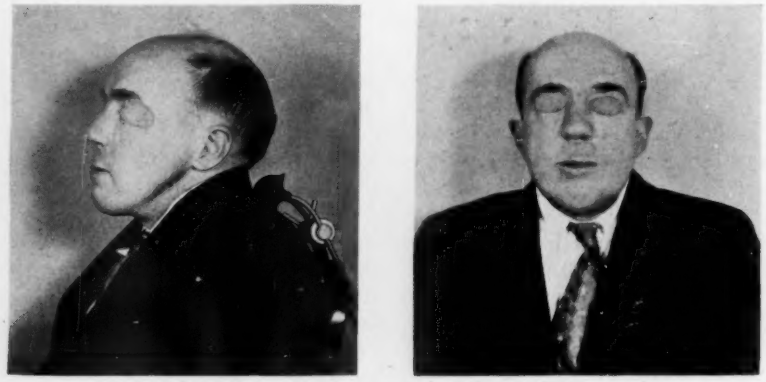

FIG. 18.—Case 5: Postoperative photographs.

lip had been repaired some years ago, but the palate had never been operated upon (Fig. 20).

Examination of the mouth showed a fairly wide cleft of the palate. She was using a poorly made artificial denture supplied with an obturator. The patient's speech was definitely nasal in tone. The lower part of the nose was quite broad and the nostrils wide,

resembling the negroid type of nose. The median section of the upper lip was thin, adherent to the alveolar process and seemed to be devoid of muscular fibers. The mucocutaneous border was quite irregular (Fig. 21). Although the cleft of the palate was

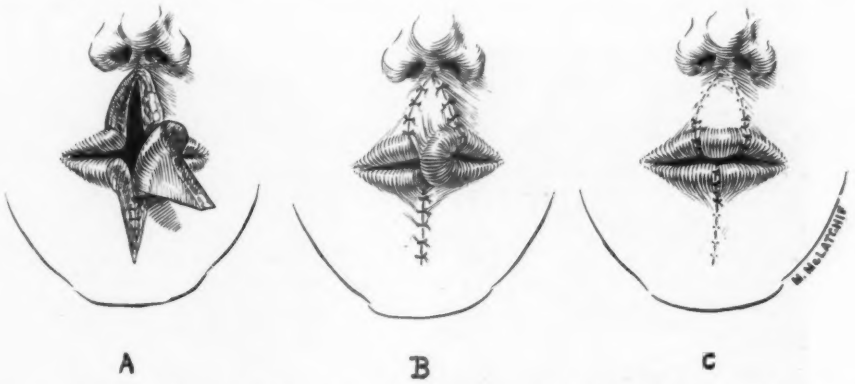

FIG. 19.—Diagram showing the various steps of the Abbe operation, which consists of transferring the median part of the lower lip to the upper lip.

suitable for palatoplasty, the patient, however, preferred an artificial appliance, which she had been accustomed to using for many years. It was, therefore, decided to operate and repair the nose and lip and then construct a new denture.

Operation.—Massachusetts Eye and Ear Infirmary: Under local anesthesia, the tip of the nose was raised, by utilizing part of the skin at the median section of the lip to

FIG. 20.—Case 6: Photograph showing cleft of palate.

increase the vertical diameter of the columella. In the meantime, through bilateral vestibular incisions, the alar cartilages were exposed. Two tongue-like cartilage flaps were made from each side and joined together in a vertical position. This procedure helped to increase the prominence of the tip of the nose and to give the nostrils a more

normal contour. The repair of the lip consisted of suturing the muscular fibers of the orbicularis at the median line. There was enough skin to close the gap (Fig. 22).

The patient was supplied with an artificial denture and an obturator of the rigid type, at the Prosthetic Clinic of the Harvard Dental School (Fig. 23).

FIG. 21.—Case 6: Preoperative photograph.

FIG. 22.—Case 6: Postoperative photograph.

Case 7.—U. K., male, age 27, had congenital cleft palate and harelip, and had had several operations. In the last operation performed, the surgeon had utilized a flap which included the tissues forming the pillars of the fauces and part of the lateral wall of the pharynx. Examination, September 3, 1935, showed a markedly retracted upper lip. The upper anterior teeth were missing while the remaining teeth were quite irregular and distorted and out of harmony in relation to the lower teeth. A large perforation of the palate was present, and evidences of considerable destruction of tissue. There was a small band of tissue, composed mostly of scars and remnants of lymphoid tissue, bridging across the cleft, at about the last molar region. The patient was using a poorly made dental plate which covered the perforation in the hard palate. His speech was quite poor. There was a definite retrusion of the upper lip and considerable deformity of the nose, the left nostril being flat and directed toward the face (Fig. 24).

FIG. 23.—Case 6: Diagram showing type of obturator.

It was apparent, after careful consideration, that operation for the reconstruction of the palatal defect was out of the question. There was not enough tissue to be utilized. The patient was, therefore, advised to have a well-fitting prosthetic appliance made for the defect of the palate, supplemented with operative repair of the nose and the lip. In order to construct an efficient dental plate with an obturator, it was necessary to cut through the scar band that extended across the palate.

Two operations were performed under local anesthesia: The first consisted of (a) ex-

cision of the scars and repair of the lip; and (b) a wide incision was made along the buccal fold under the upper lip and, with a blunt instrument, the soft tissues under the nose and the sides of the nose were separated freely from the periosteum. The entire raw area was covered with a moderately thick skin graft using a dental composition mold and

FIG. 24.—Case 7: Preoperative photographs.

a specially made appliance as a carrier for the skin graft. The purpose of this operation was to bring out the entire upper lip, the artificial denture acting as a support by virtue of its bulk.

The second operation consisted of correcting the nasal deformity, and the routine rhinoplastic procedure was carried out for the reduction of the size of the nose (Fig. 25).

FIG. 25.—Case 7: Postoperative photographs.

An artificial denture with obturator was constructed which gave considerable improvement of his speech.

Case 8.—S. M., male, age 20, was born with a complete cleft palate and harelip. He had been successfully operated upon. Examination, at the age of 10, showed the upper lip considerably retracted, the right nostril badly distorted, and the teeth quite irregular.

The soft palate was short, and there were one or two perforations of the hard palate and under the lip. His speech was distinctly nasal in tone.

The general plan of treatment outlined was to: First, regulate the teeth, especially

FIG. 26.—Case 8: Preoperative photographs.

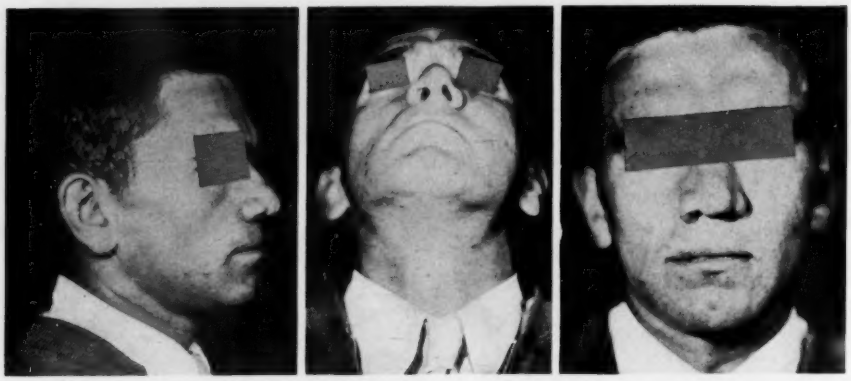

FIG. 27.—Case 8: Postoperative photographs.

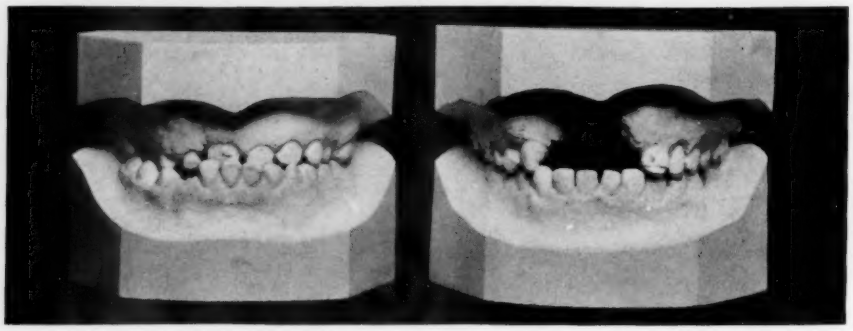

FIG. 28.—Case 8: Photographs of models taken before and after orthodontic treatment. It was necessary to sacrifice the anterior teeth in order to allow patient to wear an artificial denture with sufficient bulk along the buccal aspect of upper jaw to give the required fulness to the upper lip.

the bicuspids and molars; second, extract the maxillary central and lateral incisors and construct a partial denture which would give enough fulness to establish a normal contour of the lip; and third, operate for repair of the upper lip, nose, and palate.

When next seen, June 30, 1931 (Fig. 26), examination showed the maxillary arch

had become well expanded by Doctor Margolis, who had undertaken the orthodontic treatment of bicuspids and molars; the teeth in good occlusal position; but roentgenologic examination showed the anterior teeth either misplaced or nonerupted. The four anterior teeth were removed (Fig. 28).

Operative treatment was begun May 6, 1932, at the Massachusetts Eye and Ear Infirmary. At this operation the nose and upper lip were repaired. The second operation, September 5, 1932, consisted of repairing the palatal perforations; elongation of the soft palate; and further repair of the right nostril (Fig. 27).

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PERFORATED WOUND OF THE RECTUM INTO THE POUCH OF DOUGLAS

CAUSED BY IMPALEMENT

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BIZARRE wounds of the perineum and rectum by impalement are of interest because of their singularity, rarity, and sequelae. The methods by which these injuries are sustained are as numerous as the instruments which cause them; their severity depends upon the location and depth of the wound, the path of the penetrating instrument, and the damage to adjacent soft tissues, blood vessels, and viscera.

During the past several decades small collected series and isolated reports of such unusual injuries have appeared in the literature. The authors wish to record an additional case in which perforation of the anterior rectal wall and peritoneum by the handle of a mop was followed by a rapidly developing, fulminating peritonitis due to dissemination of liquid and solid fecal material throughout the pelvic peritoneal cavity.

Case Report.—(Hosp. No. 16649): P. U., male, age 18, slipped from the wet top of a table, and fell upon the handle of a mop which was leaning against the table, its handle rising several inches above the surface of the table. The blunt end of the handle, meeting the boy's perineum, carried him outwards, impaling him as he vaulted the arc through which the rigid implement directed the course of his body. The handle penetrated a pair of duck pants, heavy winter underwear, and entered the rectum for about eight inches (Fig. 1). The patient removed the instrument himself and, terrified, but not in pain, ran aimlessly for a distance of some 200 feet. He was immediately conscious of a desire to defecate but passed only a small amount of bright, red blood. He was then brought to the Camp Infirmary where 20 minutes later he began to experience generalized pain in the lower part of the abdomen. There was no local discomfort in the perineum except the urge to defecate which persisted. Within an hour of the accident he was seen by Dr. A. L. Wahl, who stated that at that time the boy's abdomen was generally rigid. His subjective distress did not demand the administration of a sedative. He was admitted to the Mary Imogene Bassett Hospital, three hours after the accident occurred.

Physical Examination: The patient was well developed, acutely ill, obviously in pain, nauseated, and vomiting at intervals. Temperature 100° F. by mouth, pulse 58, respirations 22.

Generalized abdominal spasm and board-like rigidity were present; tenderness was most marked below the level of the umbilicus. There was no distention. A small, irregular, superficial laceration was found in the perineum, extending into the anterior margin of the anus. On rectal examination no rupture of the rectum could be felt as far up as the examining finger could reach. Marked tenderness and moderate bogginess of the prostate were present. Bloody mucus was observed on the examining finger. The remainder of the physical examination was essentially normal.

The hemoglobin and erythrocytic count were a little above normal; leukocytes

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18,500, 85 per cent polymorphonuclear neutrophils. The bladder was evacuated with a soft rubber catheter and approximately 400 cc. of clear urine obtained, examination of which was normal except for four to eight erythrocytes and an occasional leukocyte per high-power field.

Tentative Diagnosis: Puncture wound of the perineum, perforation of the rectum, or bladder, or both, with generalized peritonitis.

Operation: Under ether anesthesia, the abdomen was opened through a midline, suprapubic incision, disclosing a generalized peritonitis, and the presence of liquid and

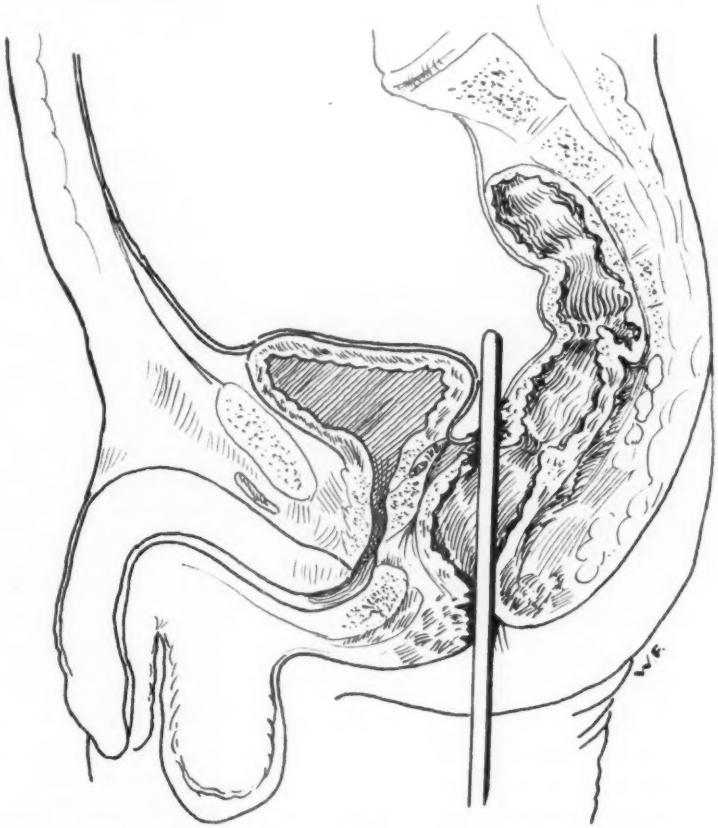

FIG. 1.—Median sagittal section illustrating the path of the mop handle through the perineum, anterior rectal wall, and pouch of Douglas into the peritoneal cavity.

solid particles of feces. As much of this fecal material as possible was removed with suction and the pelvis was walled off with Mikulicz pads. A perforation about one inch in diameter was seen in the pouch of Douglas and below this a perforation of corresponding size was found in the anterior wall of the rectum. The edges of the rectal mucosa were picked up with Allis forceps and closed with a running suture of No. 0 chromic catgut. The musculature was sutured in the same manner and the rent in the pouch of Douglas was closed and approximated to the wall of the rectum. One cigarette drain was placed in each side of the pelvis.

A loop of sigmoid was then brought out through a second small incision in the left rectus muscle near its lateral border. The midline incision was closed above and below the drains. A sigmoidostomy was immediately established. The patient was constantly cyanotic during the operation due to the presence of large amounts of mucus and other liquid material in the nostrils and rhinopharynx. However, he stood

the procedure well and left the table in fair condition. A slow intravenous drip of 5 per cent glucose in normal saline solution was started immediately after operation. As soon as he recovered consciousness he was placed in Fowler's position.

Postoperative Course: Rigidity and spasm of the abdominal wall diminished gradually and were entirely absent by the fifth postoperative day. Tenderness subsided rapidly. Drainage from the peritoneal cavity was at first moderate and consisted of thin, gray, foul-smelling fluid with the odor typical of that emanated by the anaerobic growth of *B. melanogenicums* and Streptococci.[1] The discharge became more profuse up to the tenth day and then gradually diminished. The drains in the pelvis were progressively withdrawn between the twelfth and fourteenth days. At first there was no fecal discharge from the sigmoidostomy; within a week of operation active peristalsis had commenced and the stoma was functioning satisfactorily. The abdominal wound healed uneventfully in spite of constant contamination from both the peritoneal cavity and from the artificial anus.

Within 24 hours after operation the patient developed a moist, crackling cough productive of a small amount of blood-tinged sputum. The temperature rose to 103° F., pulse to 140, and respirations to 40. Examination of the chest revealed dulness over the right lower lobe with bronchial breathing and numerous moist râles. A roentgenogram confirmed the diagnosis of pneumonia in the right lower lobe. During the following week the temperature came down by lysis, the physical signs in the chest diminished, and the patient's cough progressively disappeared.

As a preventive measure against the possible development of infection from *Cl. welchii* or other gas-forming anaerobic organisms the patient was given a prophylactic dose of polyvalent serum on the third and fourth postoperative days. Five days later he complained of soreness and aching in several of his joints and a diffuse, confluent, maculopapular eruption appeared over his entire body. At this time the temperature had again risen to 102° F., pulse to 108. A diagnosis of serum-sickness was made. The eruption disappeared two hours after its appearance, and the articular pains subsided within 24 hours; on the eleventh postoperative day the temperature fell to normal where it subsequently remained. Eleven days later the sigmoidostomy was closed. The lower intestinal tract functioned normally thereafter, and the patient was discharged in good health with both wounds healed.

Discussion.—Injury by impalement implies a fall onto the impaling instrument; in order to differentiate such lesions from the more common puncture wounds the falling body must play an active part, the impaling body a passive one. Such a description was followed by Stiassny[2] who collected and published summaries of 127 cases, in 1900. Five years later Tillmann[3] added 16 more cases, and, in 1912, Habhegger[4] summarized all the cases previously reported and added 36 additional ones which he had collected during the intervening seven years.

Incidence.—Injury by impalement is primarily a hazard of agricultural communities, yet only three such patients have been treated at the Mary Imogene Bassett Hospital, in a rural section of New York State, during the past eight years. Within this period there were 10,551 total admissions, 4,554 of which were surgical. Neumann[5] reported 20 impalements in 16,000 patients treated at the Municipal Hospital in Friederichshain near Berlin, between 1880 and 1898, and Bircher[6] found only two such cases in 16,000 surgical admissions to the Kant Krankenhaus in Aaran, an agricultural district of Switzerland. These statistics offer sufficient evidence of the rarity of this type of lesion.

Etiology.—Impalement is one of the many hazards of haying. Thirty

per cent of the reported cases have occurred among farmers[4]; falls from hay-lofts, stacks, and racks onto hay-hooks, pitchforks, rakes, and hoes are the more common methods by which this injury is sustained. Pitchforks and hay-hooks have been the impaling instrument in 26 per cent of cases. Those who work beneath the surface of the earth form the next largest group; miners, ditch-diggers, and well-drillers who run the risk of impalement on drills, picks, shovels, and gas pipes. Those who work above the surface of the earth form the third group, steeple-jacks, window-cleaners, masons, painters, and carpenters. Even the home is not safe, for many cases have been due to falls from windows and porches, stepladders, tables, and chairs onto picket fences, flower-stakes, broom-handles, and the legs of chairs and tables.

The other two injuries by impalement treated at this hospital, since 1930, were minor in character and were caused by accidents less infrequent than the case reported in detail. One was a laceration of the scrotum with extrusion of the testicle, due to a fall onto a picket fence; the other was a wound of the perineum through the sphincter ani into the rectum, sustained when the patient, who was evacuating his bowels in the woods, fell backward onto a stump.

The case herewith recorded is the only one which the authors have discovered wherein the victim was impaled on the handle of a mop.

Classification.—Habhegger[4] presents an elaborate classification and comprehensive description of wounds of this type. It seems, however, much simpler to divide them into two groups: One, in which the peritoneum is not injured; and two, those in which the peritoneal cavity is penetrated, with or without injury to any intra-abdominal viscera; peritonitis is always a complicating factor in the second group and a frequent cause of death.

In the majority of cases the direction of impact is from below upward, more or less parallel with the long axis of the body, and the point of entrance is through the anal orifice in the male and the vagina or anus in the female. The curved surfaces of the buttocks direct the impaling object toward the interischial space from which the pubis in front and the coccyx and sacrum behind guide it toward one of the two orifices. This mechanism applies particularly to blunt instruments, a pointed object being more likely to penetrate at the point of impact.

Diagnosis.—The severity of the immediate symptoms is frequently not directly dependent upon the extent of the injury, even when the peritoneal cavity has been penetrated. Subsequent symptoms are the consequences of infection and hemorrhage. Occasionally patients are not aware that a serious injury has occurred until several hours later. A careful history is important, obtained preferably from a witness to the accident, rather than from the patient. An inquiry regarding the depth to which the object penetrated, a thorough examination of the wound and all adjacent visible and palpable structures, and an attempt to visualize the direction of the impact are all of value in establishing an accurate diagnosis.

A knowledge of whether or not the bladder was full at the time of the accident, whether or not the patient voided during the interval between the accident and the examination, and whether he passed blood by urethra or by rectum is very helpful. The same is true of bleeding from the vagina in the female. Every patient with an injury by impalement of the external genitalia, perineum, anus, and rectum should be catheterized; the escape of grossly clear urine through the catheter is not definite evidence of the integrity of the vesical wall; neither does the presence of a few red cells in the urinary sediment offer positive proof that the bladder has been ruptured.

Proctoscopic examination is of unquestionable value in many cases[7] when doubt exists regarding the continuity of the rectal wall.

Generalized abdominal tenderness and spasm may develop very rapidly, even though the peritoneal cavity has not been flooded with urine or blood. Shock may be due either to fulminating peritonitis or to severe hemorrhage.

Treatment.—Early operation is imperative in all cases where rupture of a hollow viscus is suspected. Suture of the viscus or viscera; aspiration of fecal material within the operative field; removal of foreign bodies; and adequate drainage of the peritoneal cavity are essential. A colostomy proximal to the wound probably affords greater safety during the early convalescence and less danger of leakage from the intestinal repair. Acute hemorrhage, either internal or external, must be checked. Rupture of the bladder demands suture of the wound and free drainage, preferably by the suprapubic route as more efficient than the transurethral.

As in all cases of collapse from severe trauma or overwhelming infection, primary therapy should be directed toward the treatment of shock before extensive operative intervention is undertaken.

Difference of opinion exists regarding treatment of the local perineal wound. Some authors advise extensive débridement; removal of all foreign matter; accurate hemostasis; and free drainage of the retroperitoneal space; others suggest the use of tampons to control bleeding and afford drainage. In the case herewith recorded the patient was operated upon soon after the accident occurred, the retroperitoneal space below the pouch of Douglas was not drained, and the external perineal wound, involving the anal orifice, was neither débrided nor packed; there was no cellulitis of the retroperitoneal tissues and the external wound healed well.

Mortality.—The statistics of Tillmann[3] and Habhegger[4] are of interest, although it must be remembered that Habhegger's series includes the cases previously collected by Tillmann; they may best be compared by the following tabulations (Tables I and II).

TABLE I

TABULATION OF THE STATISTICS OF TILLMANN AND HABHEGGER

	Tillmann[3]	Habhegger[4]
Total Number of Cases	143	179
Recoveries	105	131
Deaths	38	48
Mortality	26.05%	26.81%

TABLE II

MORTALITY OF DIFFERENT TYPES OF INJURIES BY IMPALEMENT

	Tillmann[3]		Habhegger[4]	
	Number Cases	Mortality Percentage	Number Cases	Mortality Percentage
Extraperitoneal impalements without injury to organs	57	7.01	69	7.02
Extraperitoneal impalements with injury to organs	29	0	36	8.02
Intraperitoneal impalements without injury to organs	19	31.66	28	25.00
Intraperitoneal impalements with injury to organs	34	76.47	42	78.57

It is apparent that intraperitoneal impalement with injury to organs is the most serious type of lesion and carries an exceedingly high mortality. Peritonitis is responsible for the vast majority of deaths; shock and hemorrhage account for a few immediate fatalities, and chronic sepsis for the late mortality.

The general principles suggested in the section on treatment offer the best prophylaxis against these unfortunate sequelae.

SUMMARY

An unusual case of impalement by the handle of a mop has been described in detail; the instrument entered the rectum through the perineum and penetrated the pouch of Douglas.

Fulminating peritonitis developed rapidly. The patient was operated upon four hours after the accident occurred; the postoperative convalescence was complicated by pneumonia and serum-disease; recovery followed.

Injuries of this type are rare. Their incidence, etiology, classification, diagnosis, treatment, and mortality have been discussed briefly.

Intraperitoneal impalement with injury of abdominal viscera is a very serious type of wound and carries an exceedingly high mortality. Peritonitis is responsible for the vast majority of deaths.

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A TECHNIC FOR PRODUCING FACIAL MASKS AND MODELS

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IN ANY plastic reconstruction of the face, particularly where a depression exists, a model of the entire face, or of the area involved, is of prime importance in planning a surgical attack. The present communication will deal with the taking of facial impressions, with the pouring of a plaster model, and the subsequent production of a sterilizable model of the facial deficiency. The employment of this method will produce an exactly accurate reproduction to assist in the carving of cartilagenous, osseous or other supportive material to be used in the restoration. The model can be autoclaved or boiled. The operator can then carve his prosthetic insert in a more advantageous manner.

Technic of Procedure.—The first step is to cover the patient's face with one of the various reversible hydrocolloid compounds. The one used in this work is called Dentacol,* as its properties were more familiar to the author. Various colloidal impression materials have been prepared, but had proved not to have been an economic procedure. The colloidal materials are sterilized when they are boiled for use. Furthermore, they can be used repeatedly with very little loss. Because of this, and the fact that a commercial product tends to be more uniform in its behavior, any manufacturer's colloidal impression material is recommended, rather than to personally prepare it. All manufacturers furnish the technic of handling their various impression materials; therefore, the actual consideration of this phase need not be detailed.

By employing this colloidal material, a much better living impression is obtained than with the older method of pouring plaster on the face. Greater accuracy results, and details, even of the eyelashes, are remarkable. Furthermore, it does not stick to the hair, and undercuts cease to be a problem. The reason for this is found in the impression material's rubbery consistency. Anyone who has tried to take an impression of an ear will appreciate this statement.

The Dentacol is poured on the patient's face to a thickness of about one-quarter to one-half an inch. The breathing tubes, made from rubber catheters, are inserted into the nostrils as the Dentacol is being poured around the tip and alae of the nose. After covering the face or the part of it desired, the Dentacol is chilled with cold towels. This "sets" the Dentacol.

Plaster of paris is mixed to a fairly heavy consistency and applied over the Dentacol to reinforce it. This plaster reinforcement is poured to a thickness of one-half inch or more. It is advisable to build this plaster out to nearly the peripheral margin of the Dentacol.

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* Made by L. D. Caulk Co., Milford, Del.

Submitted for publication April 9, 1938.

When the plaster has set (about ten minutes), remove the impression with its reinforcement from the patient's face. This is accomplished by first freeing the periphery of the Dentacol impression and lifting it up from the fore-

FIG. 1.

FIG. 2.

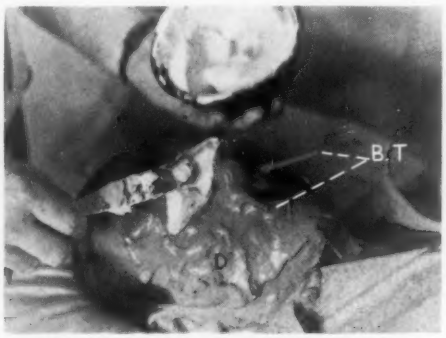

FIG. 1.—Shows the beginning of the application of the Dentacol.
FIG. 2.—(B.T) Breathing tubes installed. These tubes are sections cut out of rubber catheters. (D) Dentacol. This illustration shows the Dentacol on the patient's face and the plaster reinforcement being applied on the Dentacol.

head. Obviously the Dentacol and its plaster reinforcement are to be kept together.

Only one precaution need be mentioned, and that is not to burn the pa-

FIG. 3.

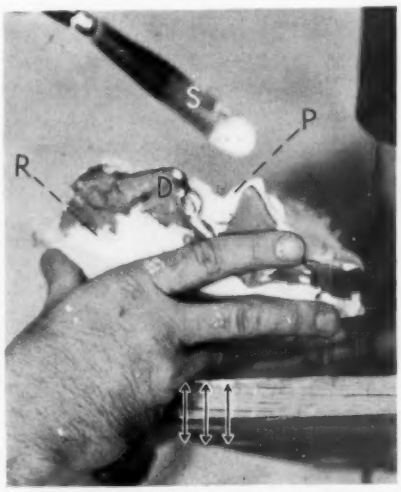

FIG. 4.

FIG. 3.—"Settling" the plaster. The illustration shows the reinforced Dentacol impression being filled with plaster while being jarred on a table top, but held in the hands of an assistant to prevent breaking. (S) Dental plaster spatula for handling plaster. (P) Plaster being added to the impression by an assistant to form the face mask. (D) Dentacol impression material. (R) The plaster reinforcement outside the Dentacol. The arrows show the direction of the gentle jars given while pouring the mask, in order to prevent air bubbles and force the plaster into all parts of the mask.
FIG. 4.—Mask completed. Showing the finished face mask after the removal of the impression material.

tient in pouring on the warm Dentacol. Test it on yourself first. Figure 1 shows the pouring of this impression material directly on the patient's face

with no previous preparation. Figure 2 shows the impression material in place and the use of dental laboratory instruments for handling the plaster reinforcement.

After the impression is obtained, proceed at once to the pouring of the facial mask or moulage. To do this, make a rather thin mixture of plaster of paris. Then have an assistant add comparatively small amounts of the plaster, from time to time. Gently jar the impression while this is being done as indicated in Figure 3. The plaster will be sufficiently set in ten minutes and the impression can be removed (Fig. 4).

One is then ready to build up the depressed portion on the facial mask to the desired height, contour and symmetrical proportion. This is done by using ordinary base plate wax, using dental wax-working instruments. To attempt, in this article, a description of the working of wax would be out of place. It is a technic that is easily acquired with practice. Anyone who can handle modeling clay can easily accomplish the same result in wax. Wax has the advantage of being smoother, and more adaptable, and can be eliminated by heat (Fig. 5).

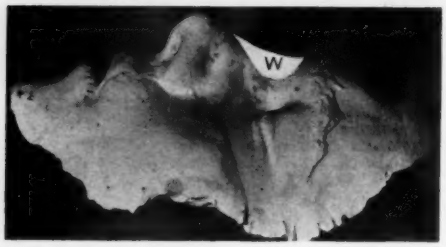

FIG. 5.—Deformity filled in. Showing the deformity on the nose waxed-up to the desired contour. (W) Wax.

The wax is then chilled with cold water to harden it. The resultant wax pattern is then carefully loosened from the mask and readapted to prevent distortion. Subsequently, this wax model will be duplicated in cast stone.*

To duplicate the wax, first partially invest it in plaster of paris. This is allowed to harden and is painted with a separating varnish. Figure 6 shows this accomplished, with the separating varnish partially applied. This will form the lower investure or part of the two-piece mold. This mold will be used to produce a cast stone model of the wax.

To produce the upper part of the two-piece mold, merely pour a mass of plaster on top of the wax in the lower plaster investure. Care is taken to extend this upper plaster investure no farther than one-half inch from the wax periphery. This will facilitate the pouring of the cast stone and leave a smaller feather edge on the resultant model. When the upper investure of the two-piece mold has hardened (Fig. 7), plunge the entire mold into boiling water for two minutes. This will so soften the wax that it can be readily removed.

After the wax has been eliminated, paint the undersurface of the upper investure or part of the two-piece mold with separating varnish. This dries in three to five minutes. One is now ready to fill the mold with a mixture of cast stone. To do this add a mass of the cast stone to the lower part of the mold, jarring it into all the crevices. Make sure there is enough cast stone

* Cast stone may be obtained at any dental supply depot.

to fill the upper part of the impression when it is forced to place. The best way to get rid of the excess cast stone, following this technic, is to carefully wash it away under a water tap. This is done as the two parts of the mold are being forced together while "seating" the mold. There is no need for

FIG. 6.

FIG. 7.

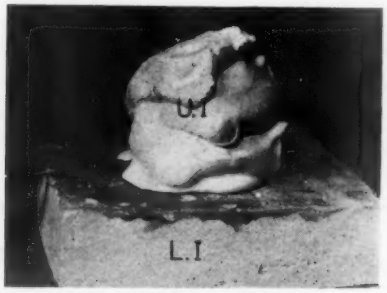

FIG. 6.—Varnishing the investure. Illustrating the wax-up, which was taken off the nose and partially imbedded in soft plaster of paris. This will form the lower part of a two-piece mold and will be referred to hereafter as the lower investure. The dry surface is then covered with a separating varnish. (V) Separating varnish. (L.I) Lower investure.

FIG. 7.—Completing the mold. Showing a mass of plaster poured on top of the lower investure to form the second part of the two-piece mold. This will be referred to as the upper investure. (V) Separating varnish. (L.I) Lower investure. (U.I) Upper investure.

haste, if the mold is first soaked in water prior to filling it with the cast stone. Allow at least 15 minutes to elapse before opening the mold (Fig. 8).

The cast stone model of the deformity is then placed back on the mask of

FIG. 8.

FIG. 9.

FIG. 8.—Removing the casting. Illustrating the opening of the two-piece mold after the cast stone model has hardened. Previous to this the wax has been boiled out and cast stone substituted. (L.I) Lower investure. (U.I) Upper investure. (M) Cast stone model which can be sterilized by boiling.

FIG. 9.—Checking the sterilizable model. Showing the sterilizable cast stone model placed on the patient's face. First it is checked for accuracy on the plaster mask, or moulage.

the face and checked for any minor irregularities. These will usually be found to be in the nature of an excess, and are smoothed off with sandpaper. The sterilizable model is now ready for use.

In a review of the literature of moulages, the author was unable to find an account given for the production of sterilizable model as an aid in carving a prosthetic insert. Inasmuch as the method used is as old as the subject of

Prosthetic Dentistry, no originality is claimed for calling use of this method to the attention of those doing plastic procedures. An excellent article on the subject of plaster, and particularly wax moulages, has been written by Mr. Carl D. Clark.[1]

SUMMARY

The method outlined has proven practical, and has actually been employed on plastic cases. With slight modifications, this method can be used to reproduce all parts of the body. The technic used is essentially one in daily use by dentists. Should any difficulty be experienced in following the technic, it is suggested that a dentist be consulted. All the materials used in this work are procurable at any dental supply house. The comparative simplicity and the accuracy of this technic recommends itself to any surgeon who desires a model to aid in the carving of a prosthetic insert.

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BOOK REVIEWS

HUMAN PATHOLOGY: A TEXTBOOK. By Howard T. Karsner, M.D. Fifth edition, revised. 1013 pages. 461 illustrations, 18 in color. Philadelphia, J. B. Lippincott Co., 1938.

This textbook, first published in 1926, is thoroughly brought abreast of the times by the present edition. Compared with the 1935 edition, the general arrangement is the same, dividing the subject about equally between general and systemic pathology. Specific changes occur under the headings of inflammation, tumors, circulatory disturbances, and the hematopoietic system, but every chapter shows alterations in the light of newer knowledge. Several new illustrations appear, and six colored plates have been added. Modernization of references has been accomplished by substitution of nearly 250 items.

The author has mobilized his material with the object of inspiring continued interest in the subject. This has naturally resulted in a text more advanced than many others, and, stressing special pathology perhaps, has made the work more useful for graduate usage and reference. It is practical in that sense without losing in didactic value. While purely medical pathology is of necessity prominent, the surgical aspects are exceptionally presented and illustrated for general pathologic work.

In as extensive a standard as this, it is impossible to elaborate subjects for special mention. Particularly, do the photographic reproductions and arrangement have exceptional clarity and value. The references are preponderantly English and furnish a bibliography of a source material almost unique in scope. Considered as a whole, it is a thorough, authoritative and stimulating text book for beginners, a worth-while possession for the practitioner, and will continue its actively sincere service for medicine and surgery.

IRVING M. DERBY.

EXPERIENCE IN THE MANAGEMENT OF FRACTURES AND DISLOCATIONS (Based on an analysis of 4,390 cases). By the Staff of the Fracture Service, Massachusetts General Hospital, Boston, Mass. Under the Editorship of Philip D. Wilson, M.D. Cloth. 1036 pages, with 1419 illustrations. Philadelphia, London and Montreal: J. B. Lippincott Co., 1938.

This sound work on fractures and dislocations immediately arrests the attention by its skeletal figures mapped in contrasting sectional colors on the inside of the front cover and the first flyleaf, which serve as visual guides for an index of the contents of the book. Following closely the arrangement of a general anatomy, each chapter has been organized by its respective collaborator in orderly sequence: Giving first the anatomic fundamentals necessary to understand the physics of the forces which result in injury; secondly,

an analytical survey of the entire number of actual cases presented in the study; thirdly, a review of the general considerations in diagnosis and management; and finally, the conclusions resulting from the study of the cases at hand. This latter, while in the form of terse generalizations, will be found to be the real essence of the book, in that all the experiences of the operators, whether their end-results proved satisfactory or not, are contracted into brief words of counsel and admonition.

The cases, of which the entire analysis is composed, number 3,985, and the total of their reported fractures is 4,390. Over 75 per cent of these cases have been carefully examined at least one year to 18 months after the date of discharge from the hospital, and the findings recorded as an end-result of the treatment, both with a brief summary of function or deformity and a symbolic representation of their status in degrees of anatomic restoration, functional capacity, and economic ability.

The illustrations are to be commended because of the hours of arduous labor which the tracings of the roentgenologic studies entailed. The use of photographic reproductions of the roentgenograms, even when made more distinct by retouching, has been kept to a minimum and the line tracings, which have been made for 85 per cent of the case histories, allow the reader to quickly recognize and review similar cases to those in his practise.

Not the least of the chapters, because of the appearance towards the end of the book, are those sections on nailing procedures in femoral neck fractures, pathologic fractures, and delayed and nonunion cases.

No doubt there are many other available surveys of fracture services from our country's large medical centers, but I have yet to find one so graphic, so honest, and so readable.

JOHN HUNTER GREENER

EDITORIAL ADDRESS

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